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LIGHT • HEAT • POWER • BYE-PRODUCTS

[Founded in 1849 as the "Journal of Gas Lighting."]

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EDITORIAL NOTES.

A Call from the Navy.

AGAIN appeal is made to the gas industry, and again there will be loyal response. This time the appeal is made to the owners of continuous vertical retorts. Anything that affects our Navy strikes home at once to every Briton; and our gas-works administrators and engineers and managers are Britons to the backbone. Therefore, Sir Arthur Churchman, the Controller of the Munitions Mineral Oil Production Department, and Mr. T. F. Winmill, the Assistant Controller, and Lieut.-Commander J. Fraser Shaw, who is also Assistant Controller (representing the Admiralty), may rest assured that where there is a continuous vertical retort, given cannel or suitable coal, every drop of fuel oil that can be secured will be. It is a call from the Navy. Sir Arthur and his staff are the vehicles now engaged in organizing the response. It is a big task, for the requirements are big. The task is to organize to the topmost point of our available resources and capabilities the supply of home-produced fuel oils.

The Controller's Advisory Committee (Dr. H. G. Colman, and Messrs. John Bond, Charles Wood, and John Young) will find their work of a congenial order, as is confirmed by the spontaneous character of the initial work—work rendered to further test and prove certain matters that had become apparent by advancing knowledge derived from research—of men like Mr. John West, Dr. Colman, Mr. Samuel Glover, Mr. J. E. Blundell, Mr. John Bond, and investigators at Manchester, Birmingham, Nottingham, St. Helens, and elsewhere. The spirit that animates gas men in this matter was seen at the recent Manchester conference [see report, p. 232] convened by Sir Arthur Churchman, and presided over by Alderman Kay, as also by the action of the Nottingham Corporation Gas Committee—a point referred to by Alderman A. Ball, the father of a son (alas! no more) of whom the country is proud—in handing-over to the Government their Radford Gas-Works for the especial purpose of producing fuel oils.

The exploration work has been highly valuable. It has placed the continuous vertical retort on a fresh plane. It has shown that such retorts can be operated to give new results in volume and quality of a class of product that was comparatively low down in the scale of preceding high-temperature carbonizing systems; and this without deteriorating gas and sulphate of ammonia yields. This is something that cannot be done by low-temperature carbonization, and so in the new disclosures the continuous vertical retorts, existing and approaching completion, are, technically as well as commercially, superior to any low-temperature system. But we are not going to say that low-temperature carbonization in gas-works retorts is the same thing as is low-temperature carbonization in specially devised retorts, because it is not. But there is no low-temperature system, specially devised or otherwise, that can give the same range of products in quality and quantity as continuous vertical retorts. And what is the reason for this success of the latter? It is that it has been found by experimenters (headed by the war-rejuvenated John West) that, by reducing temperatures at the top of the continuous verticals, more fuel oils can be produced, and by working at high temperatures at the bottom sections of the retorts (the temperatures being regulated to the character of the cannel or coal being carbonized), with steaming, the make of gas is supplemented, and cloaked and hurried-off are useful hydrocarbons which it has been our wont to degrade because we did not know how to prevent it without loss.

It is through these quite recently divulged facts that the gas-supply industry can now do so much in responding to the call of the Navy, and this without any impairment, but as a matter of fact improvement, of the production of gas and sulphate of ammonia. Low-temperature carbonization might produce more fuel oil per ton of coal, but at a considerably increased expenditure for capital and labour, and losses in gas, sulphate of ammonia, and in other ways Besides, there would be a loss in oil through a reduction of the quantity of the same quality of cannel or coal dealt with per unit of plant and per unit of time. It is no use the disciples of low temperature saying that what is claimed by gas men cannot be done. What is claimed is what has been done, and what is being done to-day, and will be done to-morrow, and for long hence, as an integral part of the work and business of the gas industry. And this without recourse to the plan of low temperatures. Low-temperature systems have been investigated by Sir Arthur Churchman and his staff. He has set them on one side as impracticable for his purposes in these times, both on account of capital expenditure, and because there is not sufficient cannel available in any one district to warrant the expenditure of (say) a million sterling on a plant, which would have to be increased as time went on. In fine, it does not seem to Sir Arthur that a case has been made out for low-temperature carbonization, owing to difficulties of various kinds.

What is wanted is that in continuous vertical retorts as much cannel as possible shall be carbonized; and vertical retorts can easily cope with all the cannel that is being brought to the surface to-day—much of which, however, is now of a second-class order. Also that where cannel coal cannot still be obtained the best quality of coal procurable shall be utilized in the continuous verticals, especially coal of good uniformity in size, as this is found to be an auxiliary condition to high yields in oil and gas per ton. Alderman Kay spoke of carbonizing cannel in the Manchester verticals as being an "eye-opener;" and Dr. Colman (detailed data will be published later) attested that large-scale experiments, worked as continuous verticals should be, were giving full quantities of oil, normal yields of gas, and quite a satisfactory production of sulphate of ammonia. So far so good. But there is the coke. Oil is the thing the Government want; and where cannel can be obtained, there should be something in the increased value of the products to help to counterbalance the loss from inferior coke. It is, however, abundantly clear that there will be more coal than cannel to be carbonized in continuous verticals; and, with regard to the proof of success, we refer to the figures supplied by Mr. West at the conference. When working continuous verticals as now advised, and a yield is obtained of from 20 to 21 gallons of tar oils per ton of coal carbonized, giving from 14½ to 17 gallons of fuel oils, accompanied by high makes of gas and good yields of sulphate of ammonia, then "highly satisfactory" can be the description applied to the results; for what Sir Arthur Churchman, in the name of the Navy, is asking for can be given with even our past gas standards of working exceeded. But if the Government want the owners of continuous vertical retorts to help them in this serious matter of fuel oils, then they must help the owners to get maximum results. The plant is one thing; the quality and suitability of the material carbonized is another. The Government are controlling to-day the sources of cannel and coal supply. Their control should be exercised in directing the most suitable material for use in these retorts. Without such aid, it is certain that the best cannot be done. Yet another matter (this is a difficult one)

mentioned by Mr. J. H. Brearley at the conference is that there are long tar contracts running; and though the value of tar may be increased, it is very difficult to get distillers to recognize this. They have their contract price for their "pound of flesh." They will give nothing more unless compelled. Suggestion from an influential quarter might alter this condition. But it is to be hoped that in future, under the changed circumstances of value, tar contracts will only be made on a basis that will yield a return according to the actual intrinsic value of consignments. This, however, is a subsidiary point. The main one is that the Navy calls for more fuel oils.

Dehydrated Tar: The Government Fuel-Oil Prize.

There are several investigators out to win the Government prize or reward of £2000—"award" is the official description—for providing them with a workable and acceptable specification for a suitable Admiralty liquid fuel containing not less than 33 p.ct. of dehydrated tar (95 p.ct. of the original dehydrated tar to be used) mixed with mineral petroleum oils. The higher the 33 p.ct. goes the better, for the Admiralty and the Petroleum Executive are anxious to get used as large a proportion of dehydrated tar as possible, this being home produced. Some men have thought the 95 p.ct. and 33 p.ct. contradictory. They have not read with care the invitation of the Ministry of Munitions. Last week we spoke of the difficulty of compliance with the condition attached—"that will utilize at least 95 p.ct. of the "original dehydrated tar." The percentage is too high in view of the free carbon in the dehydrated tar; but if only the Controller of the Munitions Mineral Oil Production Department can be satisfied that the percentage is too high, there is no doubt he will not stick out for something that will destroy his chances of getting what is earnestly desired by the Admiralty. It may be taken for granted that as near the 95 p.ct. as possible will be accepted. A far more important thing is to leave the 33 p.ct. of dehydrated tar a long way behind, and to get in the mixture its proportion as high as possible, and the proportion of mineral oils as low as possible. It was also remarked in our editorial last week that it was obvious difficulty had already been found in this matter by the technical advisers of the Ministry, or else a £2000 stimulus would not have been issued for outside competition. As a matter of fact, the Admiralty had previously carried out a considerable number of experiments in mixing coal tar and petroleum. A certain amount of success was met with; but one could not faithfully describe the results as being altogether satisfactory. Perhaps it will elucidate the position if we mention that what the Admiralty must have (the simple mention of the point will show the necessity) is a common stock of fuel—a stock which can be added to from all sources, and which can be drawn from indiscriminately. Hence the need of complying with the Admiralty specification for fuel, so that there is no restriction. Apart from the constitution of the dehydrated tar, it has been found that results vary considerably with different sorts of petroleum. Some oils, the official experiments declare, mix with the tar much better than others; and the ones which mix the best are Mexican and Trinidad. The supply of Trinidad oil, however, is at the present time almost negligible; but it is the oil that gives the most satisfactory mixture. This again, we should say, depends upon circumstances that at the present time need not be specifically mentioned while experimenters are busily at work, each in his own way.

Plant Efficiency and Washing and Grading Coal.

It is commonly admitted now that it is a national necessity to secure the greatest efficiency from the use of the country's natural resources, the chief of which are the coal measures. This admission carries with it an obligation upon every individual to use these resources, within the limits of opportunity, to the maximum advantage. On April 9, in an editorial article, reminder was given of the apposite remarks by Mr. Thomas Glover, at the recent Southern Association meeting, regarding the economic aspects of the grading and washing of coal for the production in its carbonization of a variety of commodities, and of his suggestion that the preparation of coal—having very obvious advantages in promoting volume and quality—should be one of the foremost items in the *post*-war reconstruction programme of the gas industry. Volume and quality of the various products do not exhaust the benefits; and very little consideration will clearly show this. The proper preparation of coal has large effect upon plant efficiency and selection. Whatever the character of the plant used, properly prepared coal must, of course, have excellent effect on its resultant performances, provided it is worked under the best practicable conditions. All forms of plant, apparatus, and genuine methods of operation are designed to avoid, under good management, waste of coal, products, and fuel. But the progress of knowledge shows that there are types of plant that will—given the proper physical condition of coal and methods of working—through their inherent capabilities, greatly enhance result in various ways. When this is realized fully (Mr. Glover gave some indication as to this in the remarks to which reference has been made), it will have a beneficial dual result—it will accentuate the demand for the proper treatment of coal at the pits to secure the physical condition best suited to the process for which it is intended, as well as its highest degree of purity; and it will also induce users of carbonizing plant to take the profitable course of scrapping all obsolete and wasteful plant, and installing the form which is most efficient and economical.

It is notable how efficiency promotes efficiency. Efficiency at the pits, through the process of grading and washing coal, removes dust and dirt and impurities which otherwise would deteriorate the carbonizing results. If a coal be heavy with dust, and so occupy the retort in a dense mass, this is opposed to the free transmission of heat through the charge; and there is a resistance not only to heat, but to the rapid passing away of the evolved products whatever their character. Such conditions do not promote the thermal efficiency of the settings. More fuel is necessarily required; there is harder working upon the settings; and generally the results, both in volume and in quality, are degraded. The opposite effects are realized when a coal of nutty or even of the pea variety is used free from dust, because of the facility given to the heat passing through the walls of the retort to freely penetrate the charge. Thus fuel and carbonizing efficiency are both promoted. The removal, too, of impurities from the coal, or anyway their reduction, also affects the purity of the products, which must necessarily promote economy and efficiency throughout the plant on the works—especially the purifying plant. But cleansing the coal is of vital importance to the coke; and no one can conscientiously assert that coke as produced by the gas industry has yet received the adequate attention which it deserves, if it is to be made an attractive fuel, yielding the largest possible money return to set against the cost of coal. A large ash content means a large amount of clinker. In a gas-works, this injures the efficiency of the retort-settings—not only through clinker, but through the depreciated quality of the producer gas. This, in turn, means not only additional labour, but an increase in the amount of the coke required for fuel. These drawbacks in the retort-house are merely the reflections of what takes place in the works—in boiler-houses, other furnaces, or producers—of industrial users of coke, who get tired of the deteriorated efficiency of their plants, which a transfer to coal will, they find, improve. This need not be if the gas industry begins at the right place its efforts in raising efficiency—that is, with the coal itself. Moreover, washing removes impurities from the coal; and this again produces coke containing less sulphur, and with the sulphur goes arsenic, which clearly has its commercial advantage.

From whatever point of view the matter of grading and washing is considered, it shows that it is a practical suggestion that should not be dismissed without thorough research. If through such preparation of coal, efficiency of plant can be raised, it affects capital very advantageously. Every step made to higher efficiency per unit of plant means a reduced capital cost per unit of production. And we know on good authority that it has been clearly demonstrated that gas output from a works has been retarded by the use of ungraded small coal, and has been correspondingly accelerated when graded nut coal has replaced the ungraded quality. This particular illustration is during the war supplemented by an almost universal experience with dirt-laden coal, which allows the definite submission that the capacity of any retort plant is greatly affected by the physical condition of coal, both as regards size and purity. We are insisting upon this matter, because of the belief that the advance of the industry in carbonizing practices and plant requires the helping aid of the preparation of many sorts of coal to attain the highest efficiency, and that the efficiency which could be attained would handsomely repay the industry.

Stimulus from Competent Outside Observers.

It is sometimes profitable to hear the views of an observer of an industry who is completely detached from it, but has the scientific attainments, the practical experience, and the power of commercial reasoning which, combined, give him authority for speaking plainly to that industry. Such an one is Sir Robert Hadfield, Bart., F.R.S., who has just relinquished the chair of the Society of British Gas Industries, and has left upon record something for the gas industry not only to idly ponder over, but to actively work at. His successor in the presidential chair is Lord Moulton, eminent also for his scientific (as well as legal) attainments, and a powerfully discriminating and critical mind. At the annual meeting of the Society last Thursday, both spoke of the gas industry and of its work. Both praised it for what it has done in the great crisis, both recognized its indispensability, and both see its great inherent potentiality. Sir Robert, the ex-President, and Lord Moulton, the new President, are disinterested observers of the industry; and both admit these things. His Lordship says: "It is not only "that the gas industry produces material for explosives, "dyes, and modern chemicals, but right through the problem "of the use of fuel, gas—its production, its composition, "and the modes of utilizing it—comes forward as one of "the biggest problems of civilization." Again: "In the "problem of the economy of coal, gas stands in the first "rank." And yet again: "During the war, the vital part "that gas has played has deeply impressed me." Generous recognition such as this is very welcome and highly appreciated; but we must not thereby be lulled into any sense of false security.

Warning fell from Sir Robert Hadfield. His firm pays an immense fuel bill; and the heating agents patronized are those best suited for different classes of work—viz., coal, coke, gas, and electricity. Serviceability is the only guiding factor in choice, unless there is no distinction; and then relative costs come in. Therefore, Sir Robert can speak frankly and impartially. And his warning to the gas industry is that the electricity industry is making a bold bid now in every field of heating, and that it is up to the gas industry to make its defences as strong as possible by doing everything that can be done to cheapen its B.Th.U. as supplied in gaseous form. He was speaking of fuel economy. All through this part of the address there was shown the superiority of gas over electricity in B.Th.U. supplied for a given cost, which position, of course, may be somewhat modified by the differences in the means, and the efficiencies of these means, of applying the heat energy. But upon its superiority in the matter of the cheapness of heat energy, the gas industry does not alone take stand. It does something vastly more with the coal it uses than supply heat energy in the gaseous form. Naturally Sir Robert views the matter from the point of vision of the manufacturer who wants to get his work done in the best way at the lowest cost. But manufacturers must not rest their opinions too strictly on theoretical calculations and fine-cut costs. For instance, Sir Robert asks the gas industry to bear in mind when considering electric heating, that theoretically 1 KW.-H. will heat 20 lbs. of iron up to about 900° C., and 112 KW.-H. will heat 1 ton of steel to the same temperature. This at 0·4d. per unit means only 3s. 8d. per ton. Of course, the former figures do not include thermal losses; so that the 3s. 8d. is incorrect for practical purposes, and the 0·4d. per unit is a figure for electrical energy which is only realizable in conspicuously favourable circumstances. On the other hand, Sir Robert says that 1 ton of iron or steel can be heated to the same temperature by the expenditure of about 850 c.ft. of gas, assuming that the calorific power is in the neighbourhood of 450 B.Th.U. per c.ft., which gives an equivalent total of B.Th.U. to the 112 KW.-H. Where and when the conditions are such that electricity can be profitably supplied at 0·4d. per unit, there and then industrial gas will probably be supplied (in peace times) at a little over 1s. per 1000 c.ft. Hadfields Limited have their immense works at Sheffield; and no doubt to the world-famed firm the distinction between 3s. 8d. and something under 1s. for doing an equal amount of work is fully apparent.

However, we are glad Sir Robert issued the warning, as well as that he has offered a prize of £150 for papers describing investigations into problems relating particularly to heating and melting by gas. The gas industry is not standing still. It is investigating its carbonizing problems; and it has made some large strides by changing its carbonizing methods, and by the utilization of steaming and the application of blue water gas, in providing cheaper B.Th.U., and at the same time has improved both quantitatively and qualitatively its other products. But sufficient has not yet been done. There are many problems ahead for solution, and one of the biggest of them is how to make Parliament see what Lord Moulton, Sir Robert Hadfield, Sir George Beilby, and other men of distinction realize, that a good combustible gas is what the country needs, not a gas that is more costly to produce in order to comply with some parliamentary standard, and yet does not give a superior return to consumers in flame temperature and cleanliness, but probably helps to swell the volume of the products of combustion. It would be very easy sailing for the gas industry to render greater service to the country generally and to industry in particular if Parliament and the Private Bill Authorities were constituted of men such as are named above—men who know what is wanted, and are not governed by precedent, or swayed by personal friendships or influences and political winds.

Benzol and Toluol Production.

Anyone who has been misled by the discussion at the meeting of the Midland Association of Gas Engineers and Managers on tar accumulations and dehydration, into believing that the need for the maximum recovery of toluol and benzol is not now as great as it has been at any other time during the war, will have his mind cleared of this belief by reading the letters that have passed between Mr. F. L. Halford, of the Explosives Supplies Department of the Ministry of Munitions, and Mr. E. W. Smith, of Birmingham. The letters will be found in our "Correspondence" columns.

Steaming Saves Coal and Makes Profits.

The Corporation of Macclesfield and the ratepayers of the borough are to-day highly enamoured of steaming in vertical retorts. They see in it a process that, while giving them the gas they want, saves coal and makes additional profits, higher costs of materials and labour notwithstanding. It is not surprising, therefore, that well-deserved compliments have been showered upon the Engineer (Mr. J. E. Blundell) by Alderman Isherwood, the Chairman of the Gas Committee, and by the local Press. We are glad to see this, because it shows that in Macclesfield there prevails the spirit that gives honour where honour is due. We can say to the Gas Committee and ratepayers of Macclesfield something perhaps that they themselves are not in a position to recognize, through not being in the swim of technical gas development. It is that Mr. Blundell is one of the pioneers in this matter of steaming in continuous vertical retorts, and that it is due largely to his patience and perseverance in investigating temperature and other adjustment to realize the correct retort conditions that so rapid progress has been made not only by him, but by other workers in the same field. Steaming is not a new thing in intermittent vertical retort working, and small amounts of steam used to pass into continuous vertical retorts. But the regular and scientific application of steaming in the latter, which has produced such notable results in gas make, and has disclosed virtue in other directions, is something that supersedes all that has been done before. However, the annual report of the Gas Committee shows that the make of gas has gone up from 14,282 c.ft. to 16,054 c.ft., that a considerable quantity of coal has thereby been saved, and that the disposable balance of profit is close upon £6000, compared with £3625 in the previous year. At Macclesfield steaming has come to stay.

Coal Curtailments, and Coke Breeze to the Rescue.

Information sometimes has a roundabout way of reaching interested sources. It is common knowledge that the Coal Controller has met a number of gas and electrical engineers, and has talked over the coal situation under the new conditions. But it has been left to the Electricity Committee of the Marylebone Borough Council to publish the information that the Coal Controller stated that both industries would have to use 10 to 30 p.ct. less coal. This, we take it, refers to London and the counties south of the famous diagonal line from the Bristol Channel to the Wash. Why such a figure as 30 p.ct., when the gas ration is five-sixths of that in the corresponding periods of 1916 or 1917, whichever was the greater? We are getting into a more inglorious muddle than ever over this question. However, the Electricity

Committee of the Marylebone Council are congratulating themselves on the foresight of their Engineer (Mr. A. H. Seabrook), in altering boilers for the consumption of coke breeze. They state that the reduction of coal supplies will not affect the Marylebone undertaking, as two more boilers will be fitted this year with stokers burning coke breeze; and it is hoped to get four more fitted in a short time. To be absolutely fair, gas undertakings should be supplied with the coal for treatment that is displaced by the use of coke or coke breeze. As things are shaping, perhaps coke and coke breeze will be controlled, as well as coal, throughout the counties affected by the new gas and electricity and coal rationing regulations. Anyway, the Coal Controller should see to it that coke and coke breeze are used to relieve the coal-supply hardships, and that the maximum possible supply of coal should be sent to those places that produce gas as fuel, and give half the weight of the coal back again to meet solid fuel requirements—bearing in mind, too, those not insignificant questions of the supplies needed from gas undertakings in the shape of explosive materials, acids, liquid fuel, and fertilizers.

Gas Rationing and Penalizing Prices in Paris.

In France there is much more reason for gas rationing than there is in this country; and the Paris Municipality have decided on a scheme for the purpose that should be effective, though adding to the clerical work associated with gas supply. It is a two-priced scheme; and it appears to be far less cumbrous (if not altogether fair) than a scheme based upon a proportion of the consumption for a preceding corresponding period, which likewise involves a lot of clerical and reference work, places upon gas undertakings the duty of reporting excesses, and upon the Board of Trade the duty of hearing explanations, and, if thought fit, prosecuting the delinquents. The Paris scheme leaves to the consumer the determination of whether he is to be heavily penalized, and that without any troubling of the Law Courts. He can exercise his own discretion as to exceeding a fixed point in consumption. If he does, there the matter ends; and he has to pay dearly for the excess. One objection we see to the Paris scheme is that, on the face of the information published in another part of the "Journal" to-day, it does not appear to deal specifically with industrial consumers. They are surely to be dealt with as well as domestic consumers. Nor do we observe that between ordinary consumers any difference is made according to the extent of their requirement and use. The limit of consumption at the low price appears to be fixed at one level for all ordinary consumers. A method has also been found of getting over the difficulty of the prepayment consumer. We leave readers to note the details from the translation. But what would London or any other substantial place in this country think of gas at 6s. 8d. per 1000 c.ft., and at 9s. per 1000 c.ft. for consumption beyond the fixed ration. All the Paris Municipality say to these consumers is: "If you like to pay the high price, then let your consumption exceed the dividing line between the two prices. The more you consume the heavier your penalty." Price will act as a deterrent. But there are points about the scheme that are vague; and it apparently puts large and small consumers on to a common level, which is not at all fair.

Science and the Men.

The Committee appointed by the Prime Minister to inquire into the position occupied by science in the educational system of Great Britain have reported; and the educational system is found to be sadly wanting. The Committee, of which Sir J. J. Thomson is Chairman, is an exceptionally strong one, and the members of it are capable of looking at the matter not only from the educational, but from the economic or material, point of view. If we accept as a fact that all our reconstruction proposals will be of little avail without the qualified men to carry them through, we have a starting-place which increases appreciation of the importance of the subject. From beginning to end of the voluminous report, the uppermost point—the point most emphasized and insisted upon—is that science must be encouraged as part of the curricula of educational establishments, from elementary school to university, and that there must be considerable extension of scholarships and maintenance allowances, as well as substantial provision for research. This is a very important aspect of the question. Many men and women of ability are debarred from taking their proper place in the work of the country, owing to the want of money to secure for them the training and the credentials to give them a beginning. The national resources in brain power are lamentably confined (to the disadvantage of the country) owing to the fact that its development is largely a question of the depth of the parental purse. It should be so no longer.

Obstacles to Sufficiency.

In their report, the Committee say: "The deficiency of recruits for the scientific professions and industries is so great that there is no available source of supply which we can afford to leave untapped." But there are various obstacles to be removed. Given opportunities, the first thing to be done is to ensure that citizens avail themselves of them. One means of doing this is to make elementary science, and teachings as to the real place of science, part of the work of elementary and secondary schools. If this had been done some years ago, many of our industrial magnates would not to-day be lagging behind in seeking to employ scientific workers to a greater extent than they have done. But even among them, the example and success of firms who have incorporated as an essential part of their staff scientifically trained assistants and investigators, have been an inducement to other firms to go and do likewise. At the same time, scientific workers should be given their rightful position on the staffs; and their services should be paid for in a manner befitting their training. In some cases of which we know, there are scientifically trained men who are getting no better pay than members of the clerical staff. The Committee make a note of this want of encouragement. It is a matter that should not be overlooked in the reconstruction work of industry. Concerted action should be made by all if there is to be correction—if we are to recover lost ground and gain new. It is a national matter (a matter of gravity and urgency) that men should be trained in a manner that will open and broaden their minds, that will aid their judgments, and that will stir their imaginations. The prosperity and development of the resources of the Empire and the production of our industries depend upon this. Prof. Smithells had something to say on this subject at the meeting of the Society of British Gas Industries last Thursday.

Reports of Proceedings of Gas Associations.

Though perhaps a little later than usual—owing to difficulties which are in these days inseparable from printing and publishing work—another annual volume of the reports in combined book form of proceedings of the various Associations of Gas Engineers and Managers of the United Kingdom has now made its appearance. It will be seen from an advertisement which appears on another page of this issue, that, in spite of greatly enhanced costs all round, it has been decided not to make any additional charge for the book on the present occasion; but it can hardly be expected that it will be possible to adhere to the old figure when the next volume comes to be published. However, that is in the future. What we have with us now is the "Transactions" for 1917. It extends to some 500 pages, and records the proceedings of ten different organizations during a period of unexampled stress. Questions arising out of the war, and problems which war conditions have brought to the front, naturally bulk largely in the book.

British Engineering Standards Abroad.

Correspondence has been taking place between the Government and the British Engineering Standards Committee on the subject of the extension of the Committee's activities in foreign countries; and, it is stated by the "Board of Trade Journal," such progress is being made with the plan of campaign agreed upon that translations into French, Spanish, Italian, and Russian of practically all the British standard specifications and reports will be ready shortly for issue at a uniform price of 1s. It is naturally hoped that this will lead to the extensive dissemination of British standards among all those interested in the engineering and allied industries. The work done by the British Engineering Standards Committee has gone far to secure interchangeability of parts, to cheapen manufacture by elimination of waste entailed in the producing a multiplicity of designs for one and the same purpose, as well as to effect improvement in workmanship and design, and by concentration of effort to expedite delivery and reduce maintenance charges. A vast saving to the country in the cost of machinery and finished materials has, says the writer, thus been effected; and this has undoubtedly had a marked effect in enabling the engineering industry of the United Kingdom to hold its own in general competition. The Committee have applied to the Government to assist in the work of the Local Standards Committees which it is proposed to set up in various foreign countries; and the Foreign Office have agreed that the services of Consular Officers in certain specified localities shall be placed at the disposal of the Engineering Standards Committee to act in an honorary capacity as Presidents of the Local Committees.

CARBON AND PITCH COKE ORDER.

The Minister of Munitions, in exercise of the powers conferred upon him by the Defence of the Realm Regulations, &c., has, under date April 19, issued the following Order with regard to gas-works retort carbon, coke-oven carbon, and pitch coke.

1.—No person shall, as from the date hereof until further notice, use, purchase, or take delivery of any gas-works retort carbon, coke-oven carbon, or pitch coke, except under and in accordance with the terms of a permit issued under the authority of the Minister of Munitions, or sell, supply, or deliver any gas-works retort carbon, coke-oven carbon, or pitch coke to any person other than the holder of such a permit as aforesaid.

2.—The Order of the Minister of Munitions dated Jan. 10, 1917, relating to gas-works retort carbon is hereby cancelled; but such cancellation shall not affect the previous operation of that Order, or the validity of any action taken thereunder, or the liability to any penalty or punishment in respect of any contravention or failure to comply with the same prior to its cancellation, or any proceeding or remedy in respect of such penalty or punishment.

3.—All applications for permits under this Order shall be addressed to the Controller, Non-Ferrous Materials Supply, M.S./R /C.L., Ministry of Munitions, No. 8, Northumberland Avenue, W.C. 2.

4.—This Order may be cited as the Gas-Works Retort Carbon, &c., Control Order, 1918.

PERSONAL.

Mr. Douglas M'Rae, of Lochgelly (Fife), has been appointed Manager to the Aberfeldy Gas Company, in place of Mr. John Brodie, who goes to Coupar Angus.

Mr. William Johnston, who has been for fourteen years in the service of the Belfast Corporation Gas Department, has been appointed Manager of the Larne Gas-Works.

Mr. W. A. Cartledge, the Assistant Engineer and Manager of the Swindon Gas Company, has been appointed Gas Engineer and Manager to the Congleton Corporation, in succession to Mr. Joseph T. Broughton, who goes to Haslingden.

Mr. C. B. Newton, the Water Engineer, has been appointed by the Hull Corporation Water and Gas Committee as Gas Examiner. It was reported that at Liverpool and Bristol a Corporation official had been placed in this position, and that no objection had been raised to it.

Mr. S. H. Wallis Boyns, who for the past four years has held the position of Assistant Engineer and Works Superintendent to the Oxford Gas Company, is leaving to take a similar position with the Harrow and Stanmore Gas Company. Previous to going to Oxford, Mr. Boyns was at Smethwick as Assistant for one year, after completing his pupilage there under Mr. Vincent Hughes.

The Manchester Gas Committee have voted an honorarium of £50 to Mr. F. P. Smith, the Accountant, in recognition of the extra services rendered by him in connection with the accounts of the Ministry of Munitions for toluol and other products, and for his unremitting attention to income-tax questions, which have resulted in substantial benefits to the Committee.

From what Sir Robert Hadfield, Bart., said at the meeting of the Society of British Gas Industries last Thursday, it is probable that Prof. W. A. Bone, F.R.S., will shortly be visiting industrial centres in connection with the prosecution of the fuel economy campaign. Sir Robert believes in direct intercourse as a means of educating and interesting people in such matters.

Captain Roy Forbes Irving, whose name appears in the list of those just elected associate members of the Institution of Civil Engineers, is the youngest son of Mr. D. Irving, of Bristol. Previous to the war, he was an Assistant Engineer to the Bournemouth Gas and Water Company; but in August, 1914, he enlisted as a sapper in the Royal Engineers, and is now serving in France upon special work. He is quite a distinguished athlete—playing Rugby for Bristol University and also for Bristol City.

The resignation by Mr. T. W. Harper of his position as Gas Engineer and Manager to the Forfar Corporation, to take up a similar appointment with the Ayr Gas Company, has been received by the Town Council with regret; it being remarked by Provost Moffat that, by his departure, the community of Forfar are losing the services of an official who has done very good work during the past five years. After a thorough mechanical training with the Lothian Coal Company and Sir William Arrol & Co., Mr. Harper spent eleven years as Works Engineer in the Dundee Gas Department. Then, in 1913, he went to Forfar, where he promptly set about carrying out improvements the cost of which was soon more than covered by the economy effected. Later, under his direction, vertical retorts were successfully installed. The current price of gas at Forfar (3s. 1d. per 1000 c.ft.) is among the lowest in Scotland.

North of England Gas Managers' Association.—The annual meeting of the Association will take place (under the presidency of Mr. Richard Nelson) on Saturday, the 4th prox., at the gas office, Newcastle-upon-Tyne, at 2 o'clock. Two papers will be submitted—one by Mr. Frank H. Robinson (Harrogate) on "Stresses in Gasholders," and the other by Mr. Walter Hole (Leeds), entitled "Reinforcement of District Supplies."

OBITUARY.

HARRY HERBERT JONES.

Last Wednesday, the death took place at Lytton Grove, Putney, after a long illness, of Mr. Harry Herbert Jones, aged 51, the eldest son of Mr. Harry E. Jones. Many years ago failure in health compelled his retirement from active work in connection with the gas industry.

After having been trained under his father at the works of the Commercial Gas Company, Mr. Jones for some years occupied the position of Assistant-Engineer at the Bombay Gas-Works; and he was then, in 1894, appointed Engineer and Manager of the Margate works of the Isle of Thanet Gas Company. About four years later, upon the retirement of Mr. H. S. Freeman, he became Engineer and Manager to the (then) Wandsworth and Putney Gas Compaany—which position he retained for five years. At the meeting of the Company in the early part of 1903, however, the proprietors learned with regret that Mr. Jones had been forced by ill-health to retire.

In 1900, he married Miss Alice Burstall, who survives him.

JOHN OAKEY TAYLOR.

At the ripe old age of 92 years, Mr. John Oakey Taylor, J.P., died last Thursday, at his residence, "Cravenhurst," Reading, after a short illness; and the event has removed a well-known and much respected member from the ranks of the gas industry.

In his own town, Mr. Taylor's name was a household word; and his remarkably long connection with gas affairs there had many times brought him to the notice of "Journal" readers. As a matter of fact, he had been Chairman of the Reading Gas Company ever since its incorporation in 1862; and for seven years previous to that time he was on the Board (first as Director and then as Chairman) of the Reading Union Gas Company, which was amalgamated with the Reading Gas Light Company—thus forming the present Company. In June, 1905, he was presented by his fellow Directors—in celebration of his fifty years' connection with the gas supply of Reading, and of the eightieth anniversary of his birthday—with his portrait, a photograph of the Directors and principal officers, and an illuminated address. The address testified to the intimate knowledge and ability with which the recipient had conducted the business of the Company, as well as to the dignity and unfailing courtesy with which he had carried out the duties of the chair. Then seven years later came the jubilee of the Reading Gas Company—and, of course, of Mr. Taylor's occupancy of the chair—and on this occasion, which was fittingly commemorated, he was presented by the Board with his portrait in oils; the presentation being made by the late Mr. H. B. Blandy, J.P., who was Vice-Chairman of the Company, and had also been a Director ever since the incorporation of the Company. In connection with this jubilee celebration, a retrospect was prepared by Mr. Douglas H. Helps (the Engineer), which showed how much the town and shareholders owe to the energy and the foresight which have characterized the administration of the Company's affairs.

Mr. W. A. Nash, who was for many years in the service of the Gas-Meter Company, Ltd., and who succeeded his father as Manager of the Company's Oldham works in 1912, died at his residence, Belgrave Road, Oldham, on the 19th inst., after a short illness.

Dr. Arthur H. Elliott, whose death was recorded in last week's issue, was a former associate member of the American Illuminating Engineering Society, of which he was at one time General Secretary, and later Treasurer. He studied chemistry at the Columbia University, and was graduated in sciences in 1881, after which for a number of years he remained there as Instructor in Chemistry.

Second-Lieutenant J. G. Barrett, M.C., of the 9th Battalion Loyal North Lancashire Regiment, who was killed in action in France on the 10th inst., at the age of 28, was, at the outbreak of war, Assistant Gas Engineer to the Clitheroe Corporation; his father, Mr. R. Barrett, being the Gas Engineer. On Sept. 4, 1914, he joined the 5th Battalion Loyal North Lancashires as a private, and went to the front in February, 1915. He rose to the rank of Sergeant, was recommended for a Commission in January, 1917, and gazetted the following July to the 9th Battalion. With the exception of the period preparatory to obtaining his Commission, he spent the whole of his time on the British front, of which he had traversed almost every yard. He was awarded the Military Cross in February last, for a very smart and successful raid on one of the enemy's outposts, securing a prisoner. He had fought on the Somme, and also at the north end of the Amiens battle for seven days, when his battalion was withdrawn and sent further north for a rest, but only to be plunged again into fierce fighting. He was killed instantly by a sniper's bullet, close to the town where he first entered the trenches in February, 1915.

The announcement is made that the Perkin Medal Committee consisting of members of several chemical societies, have awarded the Perkin Medal for 1918 to Mr. Auguste J. Rossi, of Niagara Falls, New York, in recognition of his work on titanium.

FUEL OIL FROM VERTICAL RETORTS.

THE CARBONIZATION OF COAL AND CANNEL.

In response to a circular letter issued by Sir Arthur Churchman, the Controller of the Mineral Oil Production Department of the Ministry of Munitions, there was a good attendance on Friday, the 12th inst., in the Masonic Hall at the Midland Hotel, Manchester, when the attention of the chairmen, engineers, and managers of gas undertakings in the country was drawn to the results of some recent experiments in methods of carbonizing coal and cannel which have been conducted at Birmingham (Nechells works), Nottingham (Radford works), and St. Helens, with the object of producing fuel oil. For this purpose the meeting was principally confined to gentlemen connected with undertakings using vertical retorts in the North of England and Midlands.

Alderman W. Kay, J.P., the Chairman of the Gas Committee of the Manchester Corporation, occupied the chair. He was supported by Sir Arthur Churchman, Mr. John West, Mr. John Bond, Dr. Harold G. Colman, the Assistant Controller of the Mineral Oil Production Department (Mr. T. F. Winmill), Engineer Commander Shaw, Mr. Samuel Glover, and other gentlemen.

The Chairman, in opening the proceedings, said the meeting had been convened, as they were all aware, by—he thought he might call him their friend—Sir Arthur Churchman, on behalf of the Ministry of Munitions, to face an exceedingly serious and difficult problem. But he (Alderman Kay) had taken upon himself to assure Sir Arthur that the gas industry—which had not failed up to now—would not fail at this moment to do all that humanly could be done to see the country through a very difficult and awkward situation. He (the speaker) was giving away no secrets when he said the position had been brought so seriously to the fore by the need of fuel oil for the Navy, thereby saving space which could be utilized for foodstuffs, and for other reasons which would be apparent to them. Another point about which they were all more or less concerned was the keeping up to their consumers the supply of the commodity they were interested in, according to the obligations imposed upon them by their several Acts of Parliament. In whatever they undertook on behalf of the Ministry of Munitions in this matter (and he believed Sir Arthur Churchman would tell them so), there could be no question of any loss in the transaction.

Manchester Experiments—An Invitation.

There was just one other feature to which he wished to direct their attention—viz., in Manchester they had a small gas-works situated in the outskirts, where there was a complete installation of vertical retorts. The works referred to had been highly successful up to now, and when he mentioned the matter of fuel-oil production to his Committee they agreed without hesitation or stint to go ahead with these works, and said they would likely make some excellent experiments which would probably be of value to the gas industry generally, in order to carry out other experiments which presented themselves. The position to-day was this: They wanted as much fuel-oil as it was possible to get. He was bound to say that the results of carbonizing cannels in vertical retorts had been an eye-opener to them at Manchester. The figures would, of course, be at their command; and he believed they would satisfy them that the project was a practical one, and more than a paying one when they looked at the good of the country. He was pleased to see so many of his old friends present that afternoon anxious (as he knew they all were) to do anything at this crisis which had arisen to again help the old country through. He had pleasure in calling upon Sir Arthur Churchman to address them.

Sir A. Churchman's Opening.

Sir Arthur Churchman, after expressing his thanks to Alderman Kay for presiding and to the gentlemen present for attending in such large numbers, said that in talking to technical men who understood their subject thoroughly, he would not attempt to be technical, because he himself was not a technical man. He knew that there were among his friends present that day a certain number of chairmen of gas undertakings, as well as gas engineers; but he need not assume that they knew nothing about the subject, because he learned that very often they gave instructions to their gas engineers. What he desired to do that day was to indicate the lines on which the Department he had the honour of controlling was working; why they were working on these lines; and why he wanted their help. Before this, however, he wanted to put before them a little of the history of his Department—called the "Munitions Mineral Oil Production Department." It dealt with the production of mineral oils from home sources and other sources. He took charge of the Department at the end of September last year. The Department had only just been formed; and it was necessary to build-up some sort of organization and to discover what were the best means of obtaining the results they all desired. Having already told them that he had no technical knowledge (Sir Arthur continued), the only possible qualification he had for the position was that he had a certain amount of business experience. When he took over the Department, it was impressed upon him that there was very great need of fuel oil for the Navy; and the best way of getting this fuel oil was also impressed upon him in other quarters. There were four sources of supply—two of them actually in existence, which might be increased, and two which were more or less problematical. The first was the shale-oil industry of Scotland, which had done extremely well in past years, and was to-day producing a considerable amount of oil for the Navy. This was the first thing they took in hand; and he thought they had pulled up the production a little. Certainly, the position with regard to shale oil was an improving one. The next source was the production of creosote oil from the distillation of tar. This, he was pleased to say, was doing extremely well, and going on particularly satisfactorily, though he hoped to put before them how it could often be improved upon at present. These were the two definite sources of supply. The others were the possibility of finding oil by boring for petroleum in different parts of the United Kingdom, and the distillation of cannel coal and other minerals for the production of oil. With regard to the question of boring, he did not want to touch upon that, except to say it was receiving the attention of the Government at the moment; and but for certain unfortunate difficulties which arose in connection with the Bill before Parliament, things would have progressed much further. But this would be remedied in the near future.

Two Schools of Thought.

With regard to the distillation of cannel coal and similar sorts of minerals, it was put before him strongly at the start that there seemed to be two schools of thought—high and low temperature distillation. As events turned out, the best method did not seem to be either high or low temperature distillation by itself. There was put before him the project of establishing retorts at a number of collieries where cannel coal was produced, and to use cannel in low-temperature retorts for the production of oil. It was, he thought, represented that the initial capital should be about a million sterling, to be increased as time went on. This project did not, however, at all appeal to him commercially; and one of the reasons why he put the scheme aside was that it was very difficult to find the quantities of cannel coal in any district which would warrant putting in any large system of low-temperature retort plant. The second reason was that there was a difference of opinion as to the best retort. Thirdly, it did not appear to him that the case had been fully made out for low-temperature distillation. Fourthly, there was the difficulty of dealing with coke, gas, and ammonia. There were also difficulties in connection with the handling of the coal; difficulty in regard to transport; and, above all, great difficulties in regard to labour and material for construction.

While these matters were under consideration, the suggestion was made to him that it might be possible to distil cannel coal by low-temperature methods in existing vertical retorts at gas-works—an idea which at once appealed to him very much. It was pointed out that, although gas-works were to-day working at their full capacity, it might be possible to get them in the summer months to continue the use of vertical retorts for low-temperature carbonization. In order to test this, it was necessary to get the use of a gas-works and to try it. He was pleased to see there that day Alderman Ball, the Chairman of the Nottingham Corporation Gas Department, who was approached at the time and who gave them most ready and enthusiastic help by putting at their disposal the Radford Gas-Works; and their first experiment was the low-temperature method of carbonization, using a low-grade Derbyshire cannel in Glover-West vertical retorts.

After that, they got the Birmingham Corporation to let them have the use of their experimental plant at Nechells for the purpose of having a test on the Woodall-Duckham vertical retorts—the idea being to follow the experiments through more carefully than they had been able to do through the limitations at Nottingham. They tried varying temperatures, and the introduction into the retort of superheated steam in varying quantities. They found, however, that at a certain temperature, and with a certain quantity of steam, besides getting the normal yield of gas, they got the full quantity of oil. He used the word "oil" instead of tar (it was a sort of crude oil), and they also got a very considerable yield of ammonia. The temperatures had been carefully noted; and this led them to the conclusion that in the Woodall-Duckham vertical retorts certain very satisfactory results could be obtained by the carbonization of cannel coal—results which gave them the oil they wanted without reducing the normal yield of gas. They received the greatest assistance in this from the Birmingham Corporation (Captain Hilton, Mr. E. W. Smith, and other gentlemen); and throughout the experiments Dr. Colman and Mr. Winmill rendered invaluable services.

They next tried at St. Helens on similar lines, with the Glover-West vertical retort plant. There they were greatly assisted by Mr. John West, Mr. Samuel Glover, Mr. John Bond, and several other gentlemen (who he hoped would forgive him if he failed to mention them). Dr. Colman and Mr. Winmill were present to follow the experiments through. At St. Helens they found exactly the same thing as at Birmingham—by following the temperatures through, they eventually arrived at a temperature at which they got the ordinary yield of gas, and the full quantity of oil and ammonia. What it all came to was this: They thought they had proved that cannel coal could be retorted in vertical gas-retorts so as to give the Government the oil they wanted, and without decreasing the normal yield of gas, but with an increase in the amount of ammonia, which was so badly needed at the present time. He hoped that wherever cannel coal could be supplied to gas-works where they had vertical retorts, they would be induced to carbonize cannel coal and give the Ministry the oil it needed. Whatever arrangement would be made by the Government (and they would be made on broad and generous lines) in

return for their willingness to help the Government in this time of trouble without profit, the Government would see that they did not lose anything on the transaction. That, in short, was the principle on which he wanted them to conduct the work.

Government Gas-Works.

In the case of Radford, they had taken over the works, and with the assistance of the Corporation Gas Engineer (Mr. Wilkinson) who had been very helpful from the start, the works to-day were being run as Government works. They had entered into satisfactory arrangements with the Nottingham Corporation—the basis being that, whereas Nottingham were anxious to help the Government, they were not at all anxious to make a profit, and they (the Ministry) therefore guaranteed that there should not be any loss. He (Sir Arthur) did not think he need say anything more about the cannel coal proposition, because he was going to leave that to his friend Dr. Colman. He thought they were all aware that Mr. John West, Mr. Bond, and Mr. Blundell had been for some time carrying out investigations in connection with the use of steam in vertical retorts, and the careful adjustment of temperatures. The effect had, he understood, been to show a considerable increase in the yield of tar in vertical retorts. He understood that Mr. West had made some further experiments, and would tell them something about them that afternoon. He hoped it would be possible for those who were anxious to help to adopt these special methods regarding temperatures and the introduction of steam, and so increase the yield of tar and creosote.

The Advisory Committee.

They had arranged for a small Advisory Committee consisting of (to start with) Dr. Colman, Mr. Bond, Mr. John Young, and Mr. Charles Wood, with power to add to their number. He (Sir Arthur) hoped that these gentlemen, who had been studying this matter pretty closely, would arrange for other gas engineers of experience to assist them, and to travel round and put before gas engineers who were not acquainted with the methods, full details to enable them to carry out the fresh arrangements. They would understand, he hoped, from what he had said that they were really able to put before them now a scheme for the carbonization of cannel coal which would mean that they were able to carbonize all the cannel coal available in the country to-day (and he hoped for more presently) which would give them oil, would not interfere with their gas in any way, and would add to the yield of ammonia. He had not touched upon the subject of coke; but it was a question which would have to be dealt with, because some cannel produced little saleable coke. Coke, therefore, would be dealt with later on. It might, however, be possible to send to some districts cannel coal which would produce good coke, and so on. But that was a matter for the Advisory Committee. He (Sir Arthur) felt, in talking to them that day, he was asking a great deal from men who had already given so much, because he did not think there was any industry in the country that had helped the Government more than the gas industry. He realized this very fully. He knew full well that, when this mineral oil production scheme was first suggested, a great deal of spade-work was done which led to nothing. To-day, however, his Department was able to lay before them a considered scheme on commercial lines. There was no reason why it should not be encouraged, or why it should not lead to the greater profit of gas undertakings everywhere. He was sure he could rely upon their assistance in this question.

Dr. Colman's Statement.

Dr. Colman said the part he had to take in the meeting was to give those present a general summary of the results, and the work which had been carried out in respect to the carbonizing of cannel in continuous vertical retorts. In regard to the use of ordinary gas coal, the object of the meeting was to get those using such coal to do their best to still further increase the yield of fuel oil which they got from vertical retorts. He was, however, not going into this question, because Mr. West, Mr. Bond, and Mr. Blundell, who had carried out the investigations on this point, would give them further results, in addition to those already published. In any case, however, the experiments made by these gentlemen showed that a good deal more could be done in any gas-works, if care was taken that the most suitable coal they got in works where they had both vertical and horizontal retorts was sent to the vertical retorts, because the more suitable the coal in respect of uniformity of size the better the yield of oil per ton of coal for gas, whereas in horizontal retorts it made comparatively little difference. The better coal, therefore, so far as practicable should go to the verticals, as it would be of advantage to the Government and to the country generally.

The special point he had to speak to them about was the question of the carbonization of cannel in continuous vertical retorts. When this question first came up, there were no data whatever available as to the matter, as since vertical retorts came in cannel had almost gone out. A series of tests were, therefore, made, in both Woodall-Duckham and Glover-West retorts using a second-class cannel so as not to give an exaggerated idea of what could be obtained. The tests were carried out first on the Woodall-Duckham retorts, at the Nechells works, and similar tests were afterwards carried out at St. Helens with Glover-West retorts. At present, as the tests were not quite complete, he was not able to put before them the detailed figures; but it was intended to publish them very shortly. The general results, however, were that at comparatively low temperatures very little oil and only about 2500 c.ft. of gas per ton of coal were obtained, and very small quantities of ammonia. At rather higher temperatures (900° C. or 1700° Fahr. outside the retort) the oil increased to 15 to 16 gallons; but the make of gas and ammonia was not increased. From the point of view of gas output, the first results of 2500 c.ft. per ton were fatal; but on further raising the temperature the picture altered, and with both systems of retorts, while an increased oil-yield was obtained, simultaneously the make of gas increased to from 10,500 to 12,000 c.ft. per ton of from 520 to 550 B.Th.U. —varying according to the temperature and the extent of the steaming—and a daily output of gas which was as large as that obtained from the same plant when using coal. Simultaneously, the ammonia yield rose from 8 lbs. of sulphate per ton to 40 lbs. or over.

Having now been able to witness actual tests on a working scale, he was glad to be able to emphasize to them that, with both the systems of continuous vertical retorts named, not only could cannel be carbonized without difficulty to produce a good yield of oil, but at the same time they could get from the plant a quantity and quality of gas substantially the same as that produced from it when using coal. Therefore, so far as concerned the fundamental matter of the maintenance of the gas supply to their district (including munition works and other large establishments essential to the nation at present), the position would not be materially affected by the change.

In respect to coke, the position would, of course, be affected, inasmuch as most cannels gave either a poor or a useless coke. This was, however, of much less fundamental importance than that of gas supply; and the disadvantages to a gas undertaking in this respect were mainly financial, and capable of adjustment. In these circumstances, he did not really think they need fear using in their vertical retorts cannel where it could be obtained. Circumstances varied, of course, in different undertakings; but in many works, where they had sufficient steam supply, if cannel was provided, there would not be any great difficulty in immediately changing over to it.

Mr. West's Experiments.

Mr. John West said most of them were aware that for some time past he had been doing the best he could in conjunction with the Ministry of Munitions in connection with the production of fuel oil which was so urgently required for the Navy at the present time; and his firm had made a large number of experiments, and given a good deal of special attention to the question of carbonizing cannel coal in Glover-West vertical retorts. Many of them were also aware that the generally preconceived idea of a number of gentlemen—most of them theorists—who had flooded the country with a lot of spurious and erroneous literature, was that this could only be accomplished by a system of low-temperature carbonization—say, at about 700° C. Well, there was no doubt whatever they could get a fair amount of fuel oil at this temperature; but what about the gas and the sulphate of ammonia? Low-temperature methods under such circumstances proved in practice to be a very costly process. Dr. Colman had told them of the deplorable state of things in regard to the initial experiments with vertical retorts at Birmingham worked at low temperatures, when only about 2500 c.ft. of gas per ton was obtained. Also that most satisfactory results were secured for oil, gas, and sulphate when higher and more suitable temperatures were employed in the same retorts. He told the Ministry of Munitions (who thoroughly believed in the capabilities of the gas industry) that he thought the gas engineers of the country would help them; but he pointed out to the Ministry that, unless they could show gas engineers that they could get a good volume of gas, he was afraid they could not put the scheme before them as a satisfactory commercial proposition. At the same time, he told the Ministry he believed that they could secure by suitable means a good volume of gas and the fuel oil into the bargain, and that they would at once set to work so as to show by experiment a more economical and satisfactory way of working out the problem. About this time, Sir Arthur Churchman very wisely decided not to be content or satisfied with the information that was placed before him and with all that had been done, but decided that practical experiments should be made at various gas-works by their own scientific experts. Fortunately—very fortunately, he thought—the Department possessed Dr. Colman. So experiments were made at Nottingham, Birmingham, and St. Helens; the idea being that they should blend their several experiences in making the final experiments together at St. Helens. *En passant*, he desired to say all the experiments were carried out on the same kind of cannel. The chief thing was to determine the most suitable temperatures to meet all their requirements. After this had been accomplished, they succeeded in producing continuously a satisfactory volume of oils as well as of gas—the gas yield being surprisingly large.

Speaking of himself as a keen agriculturist, Mr. West went on to say that they also obtained a large yield of sulphate of ammonia, which was a very important commodity at the present time. What had the low-temperature people done? They got a low yield of oils, a small yield of gas and ammonia, and wastefully and foolishly left from 8 to 10 p.ct. of volatile matter in the coke—and which practice turned out to be not a very profitable business. It was no wonder that some of them ridiculed these costly proposals. Dr. Colman was quite satisfied with the yield of gas they obtained from the experiments. In fact, he was very enthusiastic. Dr. Colman was not asking gas engineers to sacri-

fice their gas. As they would, perhaps, have gathered from what he had said, the volume of gas per ton and retort was exceptionally large every 24 hours. This was accomplished by reducing the temperatures at the top of the retorts for securing the fuel oils; while they were worked at high temperatures at the bottom for securing a good volume of gas—the average temperature throughout the retorts being from 1150° to 1200° C., or about 2150° Fahr. Steam was admitted into the bottom of the retorts in the ordinary way of gas making. In fact, everything was carried out like their previous gas-making experiments, with the exception of the reduction of the temperatures at the top of the vertical retorts.

Time would not permit of him giving more than a very brief summary of the commercial aspect of the question; but, at any rate, he thought some of them would be interested in the figures showing experiments with coal and cannel:

Table I.—Test with Cannel.

Experiments with cannel at medium and high temperatures for extracting fuel oils, gas, and sulphate of ammonia with the addition of steam for producing blue-water gas.

	Test with Low Grade Cannel for Fuel Oils.	Test with Good Cannel for Fuel Oils.
	Analysis of Cannel. P.Ct.	
	Moisture . . 2·90	
	Volatile matter 30·35	
	Ash . . . . 9·57	
Medium and high temp. taken outside the retorts . . .	1130° C. / 2066° F. Average	1150° C. / 2101° F. Average
Coal carbonized per 24 hours	19·15 tons	17·01 tons
Coal carbonized per retort per 24 hours	4·78 ,,	4·26 ,,
Gas made per 24 hours cor. .	214,000 c.ft.	223,350 c.ft.
Gas made per retort per 24 hours, corrected	53,400 ,,	55,837 ,,
Gas made per ton, per 24 hours, corrected	11,180 ,,	13,130 ,,
Tar oil made per 24 hours, dehydrated	400 gallons	Not reliable
Tar oil made per ton per 24 hours, dehydrated . . .	20·9 ,,	
Liquor made per ton 24 hours	48·6 ,,	
Sulphate of ammonia per ton	41 lbs.	
Calorific value	541 B.Th.U.	553 B.Th.U.
Total B.Th.U. per ton of coal	6,048,380	7,260,890
Fuel oils per ton, gallons . .	Approx. 17 gallons	
Volatile matter in coke . .	1·8 p.ct.	1·2 p.ct.

Analysis of Gas.

CO_2	3·8 p.ct.
Hydrocarbons .	2·1 ,,
O	0·2 ,,
CO	17·2 ,,
CH_4	30·0 ,,
H	43·7 ,,
N	2·6 ,,

The above gave a good volume of rich gas and excellent coke. Analysis not taken, but unfortunately during the night the tar-tank overflowed, and prevented the satisfactory completion of the test.

Finding there was a very limited supply of cannel available at the present time, he decided to make an experiment with some coals at about the same temperatures as they tested the cannel. They succeeded beyond expectations, as the comparison [Table II.] with a previous test with the same kind of coals showed.

Being desirous of securing more tests with other kinds of coal, he then asked Mr. J. E. Blundell, of Macclesfield, to come over and see him. He told Mr. Blundell the temperatures employed, and asked him to continue the experiments for him. He very willingly assented; and his experiments on two different kinds of coal (supplied by the Coal Controller) had more than corroborated his own tests. In fact, Mr. Blundell exceeded them. His figures were:

Average volume of gas per ton of coal carbonized of a calorific value of 500 B.Th.U. . . . . 16,782 c.ft.

Average volume of dehydrated tar per ton of coal carbonized . . . . . 20·40 gallons.

Average volume fuel oils per ton of coal carbonized. . 14·5 ,,

The testing of the tar oil was carried out by Mr. John Bond, of Southport.

There was only a difference (in regard to oil) of half-a-gallon between them. These results, then, clearly demonstrated that they were not going to be the losers by the new process; and as there were few practical difficulties ahead, he counselled them to get to work at once. He wanted them that afternoon to cheer up Sir Arthur Churchman—to cheer him up by telling him they would individually and collectively start to work as soon as possible, and give him all the oils they could. It was no use him (the speaker) talking to them about patriotism. They had risen to the occasion in the past; and he was sure they would do so again, and especially at this time of crisis. If they had been working hard in the past—well, he asked them to put another stave in. He had done his best to show them the way to set to work; and the Advisory Committee which would travel about to different works would help and counsel them in any way they wanted. There was one more matter he wished to point out. This new idea, he believed, was going to be a good commercial speculation for some of them. He thought his friend Mr. Blundell would rather go in for fuel oils than anything else. Sir Arthur had assured them they would not lose anything—on the contrary, his (the speaker's) view was that they were more likely to "make a bit."

Table II.—Test of Coals.

Experiments made separately with the same kind of coals for the production at medium and high temperatures of fuel oils. Also for the production of gas, the coals being carbonized in the ordinary way both with the addition of steam for producing blue water gas.

	Test for Fuel Oils.	Test for Ordinary Gas Making Purposes.
	Analysis of Coal. P.Ct.	
	Moisture . . 3·3	
	Volatile matter 32·3	
	Ash . . . . 7·6	
Medium and high temp. taken at the outside of the retorts.	1150° C. / 2030° F. Average	1387° C. / 2529° F. High temp. aver.
Coal carbonized per 24 hours.	14·1 tons	15·96 tons
Coal carbonized per retort per 24 hours	3·53 ,,	3·99 ,,
Gas made per 24 hours, cor. .	202,000 c.ft.	265,060 c.ft.
Gas made per ton per 24 hours, cor.	14,340 ,,	16,607 ,,
Gas made per retort per 24 hours, cor.	50,600 ,,	66,265 ,,
Tar oils per 24 hours . . .	320 gallons	293 gallons
Tar oils per ton, dehy.. . .	20·8 ,,	20·0 ,,
Liquor made per ton of coal carbonized	40·8 ,,	43·9 ,,
Sulphate of ammonia per ton	34·1 lbs.	36·9 lbs.
Calorific value	497 B.Th.U.	505 B.Th.U.
Total B.Th.U. gross, gas only	7,126,980	8,386,030
Fuel-oils per ton, gallons . .	15·1 gals. approx.	..

Test with Cannel.

Low-Grade Cannel, Tested with Steam and at Suitable Temperatures, for Fuel-Oils.

Cost of Coal, Coke, and Labour.	£ s. d.
Cost of cannel per ton .	0 16 0
Coke for furnace . . .	0 2 2
Labour and supervision .	0 1 6
	£0 19 8

Value of Gas and Residuals.	£ s. d.
Gas made, 12,090 c.ft. per ton, 500 B.Th.U., at 1s. 6d. per 1000 c.ft. .	0 18 1
Coke for sale, 13 cwt. at 4½d. per cwt.	0 4 10
Fuel oils, 17 gallons at 6d.	0 8 6
Residue (pitch). . . .	0 1 0
Sulphate of ammonia, 41 lbs. at 1d. per lb. . .	0 3 5
	£1 15 10
Less cost . . .	0 19 8
Advantage. . .	£0 16 2

Tests with Coal.

Coal Tests, with Steam and at Suitable Temperatures, for Fuel-Oils.

Cost of Coal and Labour.	£ s. d.
Cost of coal per ton . .	1 2 6
Labour and supervision .	0 1 6
	£1 4 0

Value of Gas and Residuals.	£ s. d.
Gas, 14,340 c.ft. per ton, 500 B.Th.U., at 1s. 6d. per 1000 c.ft.	1 1 4
Coke, 11 cwt. at 1s. 1d. .	0 11 11
Fuel-oils, 15·1 gallons at 6d.	0 7 6
Residue (pitch)	0 1 0
Sulphate of ammonia, 34 lbs. at 1d. per lb. . .	0 2 10
	£2 4 7
Less cost . . .	1 4 0
Advantage. . .	£1 0 7

Coal the Same Kind as above Tested for Gas-Making Purposes.

	£ s. d.
Cost of coal per ton . .	1 2 6
Labour and supervision .	0 1 6
	£1 4 0

	£ s. d
Gas, 16,500 c.ft. per ton, 500 B.Th.U., at 1s. 6d. per 1000 c.ft.	1 4 9
Coke, 11 cwts. at 1s. 1d. .	0 11 11
Tar, 18 gallons at 2d. per gallon	0 3 0
Sulphate of ammonia, 37 lbs. at 1d. per lb. . .	0 3 1
	£2 2 9
Less cost . . .	1 4 0
Advantage . . .	0 18 9

Note.—There is an advantage with the fuel-oil test over this kind of coal of 1s. 10d. per ton.

Replying to a question,

The Chairman said he was very pleased to be able to announce that the figures referred to had been checked and properly corroborated in every way. They would be circulated in due course and published. He had pleasure in calling upon Mr. Bond, of Southport.

Gas Engineers Saved the Nation.

Mr. Bond said, when Lord Moulton appealed to the gas industry for the production of high explosives, his appeal was responded to by practically the whole of the gas industry; and in his (the speaker's) opinion, the gas industry saved the nation at the beginning of the war. Now Sir Arthur Churchman had appealed to the members of the gas industry for fuel oils; and he hoped and trusted that Sir Arthur's appeal would be responded to in the same

way as Lord Moulton's appeal was. He (Mr. Bond) thought that the whole subject in connection with fuel oils had been fully touched upon by the many speakers; and this being so he felt the Chairman might well call upon gentlemen to ask Dr. Colman any questions as to the various technical problems they were confronted with, or which presented themselves to their minds at this stage.

Mr. W. Newbigging (Manchester) said it appeared to him that the note which had been sounded most strongly that afternoon by the different speakers was one they should carefully listen to. When the matter of low-temperature distillation first came out, he saw the difficulty with it would be the maintenance of the gas supply. They were, however, assured by Dr. Colman that they could proceed with the distillation of coal in vertical retorts, producing that which was so urgently needed for the Navy, and at the same time maintain the gas supply of their districts. Their meeting could not have been called at a more opportune time than now, when they had got to the end of their heavy lighting season. It was the time when they could begin to make some experiments. When his Chairman, Alderman Kay, suggested that they should do something at Manchester, and mentioned the Droylsden works, he (the speaker) at once said there was not a better place for it in the kingdom than Droylsden. They could start work better there at once, and even if they did not at first get all the results that Dr. Colman assured them they would get, they were connected-up with the Bradford Road works, so that there was no danger whatever of the district going into darkness. There was no reason why they should not commence at once at Droylsden; and they would experiment up to the full capacity of the works. He was sure the Manchester Gas Committee would give him instructions to commence at once, and go ahead without wasting a single day. After all, the question of primary importance to them was the maintenance of the gas supply. With regard to the travelling Advisory Committee, he hoped to have the assistance of Dr. Colman, Mr. Bond, Mr. Blundell, and Mr. West. These gentlemen had undoubtedly put some very hard work into the inquiry; and he was glad to hear that they were so ready to help others. He trusted every engineer willing to help would do so; and he was sure that gas engineers would welcome their visits.

Mr. H. S. Wade Deacon (the Chairman of the Liverpool Gas Company) said Liverpool would, of course, do all it could to help in this crisis. It had been done before; and they would do it now. They would consult their engineers at once. But so far as the whole question was concerned, they should certainly do all that the Government asked them to do. He had not the slightest doubt that, with the advice of Dr. Colman, Mr. Samuel Glover, and Mr. West, they would achieve as good results as were obtained elsewhere. As at present arranged, their tars were all mixed together. They would have, he supposed, to separate the tars produced from the vertical retorts from those produced in the horizontal retorts.

Alderman A. Ball (the Chairman of the Nottingham Gas Committee) said that, after the many interesting and instructive speeches they had had that afternoon, it left very little for him to say, except that some time ago he was approached by the Ministry of Munitions with regard to the experiments they wished to make at their Radford Gas-Works. He placed their suggestion before his Committee, and they very properly said, "Do whatever you can to help the Government in a crisis." He suggested to his Committee that they should hand over the works if they wanted them without profit and without loss; they did not want to make anything out of the Government in their hour of trouble. This was the key-note that should be struck by every undertaking and every board of management in the country. Their friend, Mr. West, said they "wanted a bit for themselves." He (the speaker) would add something to that, and say they wanted a bit left after the war, instead of having it at the present moment. The position was so serious to-day that they ought to lose sight of profit-earning, and when every one of them should say, "We are out to help you." He told Sir Arthur Churchman that his Committee were out to help him all they could. He hoped that this would to-day be the feeling and desire of every gas committee in the country. So far as Nottingham was concerned, they were ready to go out of their way to help the Government; and they thought they could do so without inconvenience to themselves. The experiments carried out on the Glover-West verticals at Radford had now passed the experimental stage; and he could assure them that their output of gas was in no way interfered with. They could, with all confidence, try the experiments; there was no fear that there would be any loss. Sometimes they did not want to leave too much in the hands of the Government; but he could assure them that, in Sir Arthur Churchman's department, they would get nothing but the greatest courtesy. When they had had an interview with Sir Arthur, they would find that he had only one aim and object—to produce oil to help the Navy and country in the crisis in which they were placed to-day. They all had a certain amount of patriotism in them; but he had found some people whose patriotism was affected when their pockets were touched. Let every man, he said, who was interested in the gas industry make up his mind to sacrifice something for the good of the country. They had sacrificed their lads, and (he concluded) "for God's sake don't let it be said that we are afraid to sacrifice our money to win the war."

Mr. W. W. Woodward (Salford) said they were in the fortunate (or unfortunate) position of having some vertical retorts at Salford, but they were not finished, and if he were to say anything, it would be to call Mr. West over the coals because of that. When they were finished, they would certainly try to do something in the carbonization of cannel for the production of oil.

Mr. West said the delay of the Salford verticals was due to the fact that they could not get the materials.

Mr. Woodward (continuing) said it might be interesting to know that the Staveley pits at one time raised an enormous amount of cannel. At Salford, they used to take 40,000 tons of it a year. Manchester also took a lot; and it was very good cannel. If the pit could be reopened the supply would be very useful.

Col. Eunson (Northampton) said that he was in a more fortunate position than Mr. Woodward, in that he had got his second set of vertical retorts just completed. He must, however, remark that they had done very well in regard to their yield of tar; for they had been steaming now for the last two years, and had had good yields of tar and ammonia, with a correspondingly good yield of gas. If they could get some cannel, they would do everything in their power to turn out some fuel oil. Unfortunately, at the present time they were, he thought, the last town on the line to the North to be put into the Gas Rationing Order. He did not know how the Order was going to work, because Northampton was a town with a lot of munitions factories. If they did decrease, they would have to knock down their horizontal retort supply; and then he supposed they would get into difficulties with the Ministry of Munitions with regard to benzol. Northampton was as anxious as anybody to see this matter through; and they would, therefore, be very pleased to accept the invitation from Manchester to see what they were doing.

Mr. J. H. Brearley (Longwood) said that, as a user of vertical retorts, he had listened with great interest to the speeches; and he was sure his Board would, so far as they could, do whatever was possible to help the Government in their requirements for fuel oil. They had been for the last fifteen months supplying gas made entirely in vertical retorts, so that the proposition was one affecting the entire output of their gas. He did not, however, see any difficulties ahead. They already carbonized about nine different kinds of coal; and he was therefore glad to hear from Sir Arthur Churchman that there was a possibility of getting the coals they required. He was already using one cannel coal; and he would be glad to go in entirely for cannel if he could get it. There was one unfortunate feature in their case. They sold their tar to a tar-distiller. Two years ago they went into the market to sell their tar, and only got a single offer. He seriously thought there should be some adjustment of the question of the price of tar.

Mr. John Foster (Birmingham) said, in the first place, he had to apologize for the absence of Sir Hallewell Rogers, the Chairman of the Birmingham Gas Committee. He could assure Sir Arthur Churchman that he could rely upon Birmingham, in so far as it would not interfere with the supply of gas, because Birmingham was now being called upon to supply gas to munition factories in very large and increasing quantities. There was one question he desired to ask Dr. Colman. At his works, they had both horizontal and vertical retorts. Could the tar from the vertical plant be put with the tar from the horizontals, or was it necessary to separate them? If they could be run together, the proportion would be about one-third and two-thirds respectively.

Dr. Colman did not think there was any necessity to keep the oils from the verticals using coal separate from those of the horizontals; that would only apply in the case of works which were asked to deal with cannel. In the case of cannel, they did not know exactly what supplies they were going to get. As soon as they were certain what the supplies would be, the cannel would be allocated to such works as were best able to deal with cannel in the separation of tars. Every works differed in this respect; and the whole question of the conditions prevailing in a works would be considered. There were some works where the tars were entirely separated; but the thing which would affect all of them immediately was this question of trying to get the best yields out of ordinary coals. The subject of separate storage and separate condensation would come on later. The question about tar, raised by Mr. Brearley, was a very thorny one; and every effort would be made to have the matter adjusted in the respect mentioned.

The Chairman said (supplementing Dr. Colman's remarks) he believed that was the intention of Sir Arthur Churchman when he appointed the Advisory Committee. He would like to hear what Mr. Samuel Glover, on behalf of the Institution of Gas Engineers, had to say about Sir Arthur Churchman's proposals.

The Institution of Gas Engineers.

Mr. Glover, after thanking Alderman Kay for the opportunity to speak on behalf of the Institution of Gas Engineers, felt there was little for him to say, because the whole meeting was a confirmation of what he told Sir Arthur Churchman. When the matter was mentioned to the Institution of Gas Engineers, it was at once felt that the Government could rely upon the loyal help of all gas engineers in the country, and that whatever assistance they could render would most willingly be given. The meeting that day—representing, as it did, works carbonizing in vertical retorts in the North, South, East, and West (he was glad to see the Gas Light and Coke Company represented, by-the-way)—was a complete justification for the assurance he gave Sir Arthur

Churchman of what gas engineers would do. He thought the meeting that day had proved to Sir Arthur that he came to the right department; and it was also very gratifying to him (Mr. Glover), bearing in mind the promise he gave to Sir Arthur. Referring to the appointment of the Advisory Committee—a most excellent one he thought—he knew they were on right lines when they got Dr. Colman; and in Mr. Winmill they had a scientifically minded man of no mean order, who would assist them very materially. On behalf of the gas industry as a whole, he assured Sir Arthur of the continued attention of gas engineers to the matters he had mentioned.

Sir Arthur Churchman wished to express his thanks on behalf of the Department and the Government for the very kind and helpful things said that day. He fully appreciated the fact that the gas engineers and the country were out, so far as they were able, to help the country out of the difficulty in which they found themselves. He was really most grateful to them, and appreciated it very highly indeed.

Commander Shaw thought it was hardly necessary for him to emphasize the urgent need of fuel oil, as to-day they were dependent to a very unpleasant extent on over-seas supplies for the oils which were so necessary for the Navy. It had been pointed out that oil fuel was required; but he was not sure that it had been pointed out why it was essential to use oil with its attendant disadvantage of over-sea transit, instead of home-produced fuel such as coal. If any of them had worked with liquid fuel, they would know there was no comparison at all between the comfort and ease of working with liquid fuel as compared with working with coal. The whole question of using liquid fuel had been very much considered by the Admiralty, especially since the submarine menace became a serious matter. It was quite impossible to revert to the use of coal, if they wanted to get the size of ship and the speed of ship. In the first destroyers which were built for oil they followed on the set of destroyers which were built for coal, and the engines were practically the same. The coal destroyers were considerably larger than the oil destroyers; and they had actually five boilers, as compared with four boilers of practically the same size where oil was used. Now, however, the boilers used for oil were much larger than could possibly be fitted if coal were used; and it would mean that the ship would have to be made twice the size to get the same speed out of her. Some of the big ships consumed over 1000 tons of oil a day when steaming full-speed. To build a coal ship to give the same horse-power was an impossibility. To a certain extent he represented the Admiralty at the meeting that day. Sir Arthur Churchman had expressed to them the thanks of the Government for their efforts; and, on behalf of the Admiralty, he wished to add how thoroughly they appreciated the efforts which gas undertakings had made on their behalf. He had much pleasure (in conclusion) in proposing a hearty vote of thanks to Alderman Kay for presiding that afternoon.

Mr. Winmill seconded the motion, which was heartily carried.

Alderman Kay briefly returned thanks, and the meeting then terminated.

Gas-Hoated Incubators.

During the past few winters, American gas companies have been taking on a large amount of house-heating business, a great proportion of which it is felt will doubtless continue with them permanently; and, this being the case, it is pointed out by Mr. Gilbert C. Shadwell, in the pages of the "American Gas Engineering Journal," that every essentially summer load which can be secured assists towards keeping busy the whole year through that part of the plant which had been occupied with providing gas for house heating. In this way, additional importance attaches to the market that poultry incubation affords. It has, he says, been found that, if heat be artificially applied to the eggs in an incubator, so that they retain a temperature of from 102° to 104° Fahr., they will hatch, provided other conditions are properly taken care of. Often any temperature between 100° and 105° will bring results; but for ensuring the greatest satisfaction the mean of the first figures—103° Fahr.—should be maintained. This is effected by means of a thermostat located in the machine. Gas fuel probably costs about the same as kerosene; but it possesses the important advantage of being usually constant in supply and unlikely to fail. The method of heating the eggs which is explained in the article is by the circulation of hot water. Heated air is employed to quite an extent, but is found to give variable temperatures throughout the appliance, and dries the eggs. Hot water is also to be preferred owing to the fact that, even should the source of heat fail for an hour or so, the heat left in the water may prevent absolute chilling of the eggs. After hatching, a gas-heated brooder may be used; and as this machine is usually located out of doors, the gas consumption required is naturally far higher than that for the incubator. Thermostatic control is adopted also for this purpose.

At the annual meeting of the Society of Glass Technology, Mr. W. F. J. Wood, of Barnsley, in his Presidential Address, reviewed the progress of the industry in this country since the outbreak of the war, and said he was sure that if the promising development in the chemical, scientific, and heat-resisting glass trade was to be retained, protection would certainly be necessary. Every section of the trade should unite and form a federation.

ELECTRICITY SUPPLY MEMORANDA.

There has been a vast amount of talk over what the Coal Conservation Sub-Committee of the Reconstruction Committee had to say in their report regarding the reconstitution of the electricity supply industry, the provision of super-generating stations, and the reorganization of future management. Linking-up has been looked upon by the super-station men as a futile method of bringing about improvement generally in the electricity supply system of the country, and as threatening a positive check to the more ambitious proposals. At the same time, there are other men who regard—and we think rightly—linking-up as the first legitimate and proper step in a real constructive policy. There can be no disputing that it is the most economical way to the objective of greater concentration of generation. Apparently, the Local Government Board and the London County Council are of this opinion; and they feel no obligation to be bound by what the Sub-Committee, or Mr. Merz, or even Lord Haldane, thought or said, nor to have their powers as to loan sanctions curtailed by the fact that a Board of Trade Committee now sitting, have under consideration the future lines of electricity supply development. They apparently believe in linking-up. Without searching back for examples, we see in recent issues of our electrical contemporaries that the Local Government Board have sanctioned the borrowing of £3000 for inter-connecting the Newcastle-under-Lyme and the Stoke-on-Trent undertakings. The Director of Electric Power Supply at the Ministry of Munitions has also intimated that no extensions of the South Shields electricity plant would be entertained until inquiries had been made as to whether neighbouring concerns could supply in bulk. The Council have only inquired of the Newcastle Electric Supply Company; and it is stated that the quotation works out higher than the cost at which the South Shields plant can itself generate. The Finance Committee of the London County Council have also had under consideration large loan applications for extensions from Hackney, Poplar, Shoreditch, and Stepney; and they have drawn attention (we believe some of these concerns are already interlinked) to the desirability, from a financial point of view, of effecting the largest possible measure of co-operation, so as to avoid all unnecessary extension. *Liaison* of this kind is the sensible course. Huge castles are not built in a day. Linking-up is the right movement; and it will lead to those developments that will throw more light upon ultimate requirements and costs than can all the talk around tables by a body of men only some of whom are experienced in the technical developments of the industry up to the form in which they have material being at the present day. Anyway linking-up is going ahead; super-stations are only being talked about.

The Right Road.

Pithead Low-Temperature Carbonization and Coke Transmission.

Those electricians who are contemplating low-temperature coal carbonization, and the distant distribution of electricity and the secondary products from the carbonization, in order to save railway transit of coal, will not object to having attention directed to the fact that a truck of coal produces by low-temperature carbonization nearly two trucks of coke. Therefore, if it is intended that the coke shall be consumed as smokeless fuel for household purposes, the suggested saving in the carriage of coal is a delusion and a snare. For every truck of coal, nearly two trucks of coke will have to be run. This is a fundamental fact that should be borne in mind; and Nature should be thanked for concentrating in coal so much that can only be released by carbonization, and yet so much that can be carried about the country to carbonizing plants in the handy form of coal. The pithead carbonizers, in their unwisdom, want to undo, immediately at the place of Nature's storage, the good that she has there wrought, in the packing of her gifts for transport.

Linking-up Gas and Electricity Works.

The point just made—not for the first time in other manner—appears in the address Mr. W. Chaney delivered at the last meeting of the Midland Association of Gas Engineers and Managers [*ante* p. 95]; and in more than one way this deliverance was intended for electrical as well as for gas engineers. Mr. Chaney has had an experience which few gas engineers can claim in quite the same form, and a still less number of electrical men. Our readers know well of this experience, but our electrical friends do not; and an epitome of the experience will be interesting to them in these days of discussion as to the future of their generating systems. It may be prefaced with the remark that we believe that concentration of electricity generation will take place to a very considerable extent by the amalgamation of the smaller stations with the larger. But we do not believe that a few schemes of generating plant put down in bulk at or near to collieries will result from the present discussion; and this on both technical and economic grounds. Neither the technical nor the economic consideration of the matter has yet been completely collected and examined in detail. Nor have the alternatives been thoroughly investigated. At the Saltley Gas-Works of the Birmingham Corporation, Mr. Chaney has under his charge a coke-oven installation, and the gas and the metallurgical coke is consumed close at hand. Little is therefore spent

in distribution. Electric current for handling the carbonizing plant is generated by steam raised by breeze-fired boilers; and the coke dust with the exhaust steam from the electrical plant are converted into producer gas for heating the carbonizing plant. The coke dust yields from 45 to 50 lbs. of sulphate of ammonia per ton; and this more than covers the whole of the labour involved in the manufacture of the producer gas. All operations co-ordinate and balance; and fluctuations in the amount of coke, gas, or electric current required may be taken up by the producers without stand-by plant. This points the way to interlinking gas and electricity undertakings. Coke dust and other low-grade fuels, together with the exhaust steam from electric generating undertakings, could be converted into producer gas, from which sulphate of ammonia would be extracted. The producer gas could then be bifurcated—the part required being taken to the electricity station for gas-firing boilers to raise steam for generating electricity or for engine use direct; the other stream carried to the carbonizing plant. At the generating station, peak loads could be taken up by gas-engines—thereby saving stand-by boiler plant. Coal would not have to be bought and carried to the electricity station; the coal-handling plant at the gas-works would be worked at better load, the nitrogen in the coke and low-grade fuel would be recovered as sulphate of ammonia from the producer gas. Is there not a practical scheme here for the consideration of electrical men? A similar line of working is proposed for the Alloa Gas and Electricity Works, where there is already to be found an object-lesson in fuel costs, as will be seen from Mr. J. W. Napier's figures on p. 588 of our issue for March 26.

A National Kitchen Electrical Equipment.

Over the inauguration of the Poplar national kitchen Lord Rhondda shed the radiance of his presence. The fact was referred to in the "Journal" [p. 48] a fortnight since. In the Daily Press the remarks of the Food Controller were regarded as being of more notable importance than the equipment of the kitchen by electrical and steam appliances. Local authorities owning electricity concerns and not gas undertakings will naturally turn to electrical appliances when they can get them; and the National Kitchens Department of the Ministry of Food are, in these days when the maximum food economy and the best food supply for the people are *desiderata*, glad enough to get the assistance of any heating agent—gas, electricity, coal, or steam—to give effect to their ambitious scheme. Those who are concerned in the provision of gas-heated equipment for national kitchens may be interested in a few notes as to the electrical equipment at Poplar; and for these we are indebted to a full description that has appeared in the "Electrical Times." There is a treble oven electric range, a three compartment bakers' oven, a carving-table and hot cupboard, several boiling-plates, and a couple of grills supplied by the Brompton and Kensington Accessories Company, Ltd., a special form of oven designed for communal kitchens by Messrs. Belling & Co., and several steam boiling-pans and a vegetable steamer by Messrs. Mabbott & Co. The "B & K" range has three ovens, measuring internally 1 ft. 8 in. × 1 ft. 6 in. × 2 ft., a cooking area being given of about 5 c.ft. The heating is by side elements, 3 kw. per oven, with three-heat regulation. The pastry-oven is in three compartments, each measuring 4 ft. 5 in. × 2 ft. 5 in., with heating elements both top and bottom, and three-heat control. The two grills are each loaded to 5·2 kw., and are divided with separate single heat control. Two boiling-discs for keeping soup hot are loaded to 1000 watts apiece, with three-heat control. The other boiling-plates for sauces are loaded to a maximum of 1400 watts, with three-heat regulation. The carving-table and hot closet measures 6ft. 6in. × 2 ft. 6 in., and has elements at the back of the cupboard loaded to a maximum of 4 kw., controlled by four switches. The Belling oven, which is of sheet metal on an angle-iron frame, measures 48 in. × 25 in. × 23 in., and is lagged with 1½ in. of slag wool. It is heated by no less than twenty-four elements—twelve each side, arranged in two vertical rows. Each unit is loaded to 250 watts; so that the full load is 6 kw., with three-heat regulation. It is claimed that a temperature of 400° Fahr. is reached within fifteen minutes, starting cold. The oven has six detachable racks; and it is credited with a capacity for nearly 1 cwt. of meat. It is also mentioned that on the first day the oven was installed 100 lbs. of meat were cooked (sufficient for 600 persons), together with eight vegetable dishes (100 portions) and eight rice puddings (also 100 portions). The power consumption was 45 units, which, at 1d. per unit, works out to 3s. 9d. Other electrical equipment is to be installed, including a "B & K" cabinet oven, loaded to 7·2 kw. At full heat, the connected load of the apparatus at present installed is 49·1 kw.; and this will be increased to about 60 kw. when added items take their place among the present elements of the equipment.

National Kitchens—the Standard of Cost.

Gas apparatus is going to make a very good showing in the schemes for National Kitchens; but electricity is also taking part—where the electricity service, as we have said before, is in the hands of the local authority. Reference has been made to the example at Poplar. Marylebone has also an electric kitchen; and Hackney is going to have two—all electricity supplying authorities. But Hackney is showing a 33 p.ct. disinterestedness by having a third kitchen equipped by the Gas Light and Coke Company. A curious feature about the arrangement is that the Electricity Department will have to take as their standard the costs of the Gas Company. The electric cooking apparatus is to be charged at the same price per kitchen as the equipment by the Gas Company. The "Electrical Times" says the figure appears to be £418 10s., and covers the cost of plant and utensils, together with the necessary fixing and fittings, but does not include the cost of counters, tables, outside drainage work, and so forth, which will involve a further outlay of some £200. Whether the electrical apparatus will have the same capacity and range as the gas apparatus is not stated. Maintenance, too, of the electric kitchens will be at the same price per kitchen as that incurred in connection with the gas kitchen; and current is to be supplied at a like rate per portion of food served as that charged in the case of the gas kitchen. Per "portion!" This will be a delicate matter to properly adjust. The comment of our contemporary is: "This arrangement seems quite reasonable, and should certainly not involve the Electricity Department in any loss, since the maintenance of electric-cookers and utensils used with them is unlikely to prove a heavy item, while the current consumption per person served may in practice work out at a lower cost than that of gas!" We will not comment on such a friendly arrangement. But it would be interesting to know two things: (1) Is all the work—water heating included—to be done by electricity in the electric kitchens? (2) Why were not the capital, maintenance, and running costs based upon electricity, instead of on gas?

How a Marylebone Order Was Cancelled.

That some Electricity Departments are trying very hard to drive a salient into the cooking front of the gas industry, and to broaden it out, is shown by what has happened in connection with the national kitchen at Marylebone. We will let the "Electrical Times" tell the story:

> It is of special interest to note that the original scheme provided for an equipment of gas-ovens, and that the order actually had been placed without giving the Electricity Department an opportunity of submitting its proposals. Protest having been made to the Council, the Department was asked to make an alternative to the very favourable offer submitted by the gas people, with the result that the department's offer was accepted. Under the arrangement finally agreed upon, the Electricity Department has installed the whole equipment free of first cost, current being charged for at ¾d. per unit (*plus* the temporary war advance), ¼d. per unit being set aside as a sinking fund towards repaying the capital cost of the equipment. This method of charging has been adopted for some time with very great success by the Marylebone Electricity Department, and is one of the alternatives under its well-known "telephone" system.

Such a thing would not have happened if the electricity supply had not been in the hands of the Borough Council. We will not say more than that it is not exactly above-board treatment to place an order outside and afterwards to retract in this way. The manner in which the Electricity Department managed to get the Borough Council to make this somersault is interesting. Current is to be charged at ¾d. per unit (*plus* the temporary war advance), and out of the ¾d. one-third is to be set aside as a sinking fund to repay the capital cost. Thus electricity is being charged at only ½d. per unit, *plus* the war advance, without even a lump sum payment preceding. Is the maintenance also going to be paid out of the ¾d.? While the electrical equipment comprises ranges, pastry-ovens, boiling-pans, and double fish-frier, a number of steam-cookers have been provided, mainly for the boiling and steaming of vegetables and puddings. There are two 80-gallon and two 60-gallon boiling-pans, a four-compartment wet steam oven, and a steam-heated cabinet type hot closet.

INCOME-TAX ALLOWANCES.

Wear and Tear and Obsolescence.

In a memorandum issued by the Board of Inland Revenue on the subject of income-tax allowances for wear and tear and obsolescence of plant and machinery, it is pointed out that the existing law authorizes (in addition to the allowance made in respect of the cost of repairs to machinery or plant) a deduction in assessing profits of such an amount as the Commissioners may think just and reasonable during the year for wear and tear of any machinery or plant. There is no statutory limit to the sum allowable in any year; but the aggregate amount of deductions must not exceed the actual cost of the machinery and plant to the person by whom the concern is carried on.

Though no fixed scale of allowance is prescribed by law, definite rates of depreciation on different classes of machinery have, on application by representatives of the industries concerned to the Board of Inland Revenue, been agreed upon in a number of cases; and these are generally adopted. These agreed rates of depreciation are set forth in a schedule to the memorandum; and they include, for gas undertakings other than those owned by municipal or other public authorities, 3 p.ct. on the written-down value of gasholders, and 10 p.ct. on the written-down value of meters, cookers, and gas-fires. In nearly all the cases enumerated in the schedule, the rates were fixed under pre-war conditions; and instances have now arisen in which machinery is suffering from exceptional wear and tear. In all such cases, applications for special rates of depreciation are entertained; but it is added that generally speaking the circumstances of the individual cases are

found to vary so widely as to render it impracticable to fix a uniform scale, and so each application is dealt with on its merits.

Then there has been in operation, for the past twenty years and more, in addition to the allowance for wear and tear, an allowance for obsolescence, owing to the fact that machinery frequently becomes out of date, and has to be replaced, before it is worn out. Where new and improved machinery is so introduced, the Board agree to the deduction from the profits of the year of so much of the cost of replacement as is equivalent to the written-down value of the machinery replaced, less any sum realized by the sale of it—the balance of the cost being treated as an addition to capital. As an alternative to the allowances for wear and tear and obsolescence, the cost of renewing the plant and machinery may be claimed as a deduction; the amount allowed being the actual cost of the new plant and machinery (excluding any part attributable to additions or improvements), after deducting the scrap value or realized price of the plant and machinery replaced. Buildings and other wasting assets do not come within the scope of the allowance for depreciation; but the full cost of maintaining trade premises in proper working order is allowed in computing profits.

For concerns controlled under the Munitions of War Act, the income-tax allowance has been temporarily extended; the Commissioners being authorized by the Finance Acts of 1916 and 1917 to revise it so as to enable a deduction to be made from profits of the difference between cost and post-war value of installations and extensions, including buildings, which would not have been undertaken except for the war and the express requirements of the Government.

THE IMPORTANCE OF COAL GAS IN WAR TIME.

By "Cricket."

The campaign that the technical gas publications are conducting in regard to the vital importance of coal distillation in war time is having its proper effect on the various Government Departments. It would not occasion the writer the least surprise if shortly gas undertakings were urged to distil as much coal as possible and make as little blue gas as possible.

Following the demand for a larger quantity of fuel oil for the Navy, a demand may be expected for a greatly increased production of crude benzol per ton of coal carbonized. It cannot very well be otherwise. The present military operations, and the published fact that we have more guns than ever at the front, determine the matter. The demand for larger quantities of explosives is an obvious corollary. All gas engineers and managers should, therefore, be studying their benzol plants with a view to considerably increasing their output, and those with plants in course of erection should do their utmost to get them going as soon as possible.

The Government Departments must, however, put their heads together. For instance, the Mineral Oil Production Department naturally requires fuel oil, and suggests that low-temperature carbonization should be carried out with cannel and suitable coals at all vertical retort installations. But vertical retorts do not usually produce benzol suitable for explosives. The benzol produced ordinarily contains so large a percentage of paraffins as to be practically useless for explosives. On the other hand, horizontal retorts form benzol quite suitable for explosives. The inter-departments should therefore ensure that "suitable coals" are distributed fairly to both vertical and horizontal installations, in order that each department may get its fair share of the products it requires, and not be pulling against each other.

Both systems, however, must have the necessary coals. The two vitally necessary products—fuel oil and explosives—to keep the enemy from our shores are quite sufficient to place the distillation of coal at gas-works and coke-oven works at the top of the list (even above shipbuilding), because steel cannot be manufactured without metallurgical coke. Then there are the hundreds of other products from coal distillation vital to a country at war; and all have to be extracted from only 18 p.ct. of the total coal consumed annually in this country.

Gas-works are still being starved of coal—and in many instances have but a few days' stock. Some have closed-down their benzol plants; otherwise (with the large percentage of blue gas) the gas supplied to consumers would cause too many complaints.

The writer would repeat that the rationing of coal to gas-works is a grave error—especially at this exceedingly important stage of the war. It is nothing short of madness. House coal should only be 50 p.ct. of the present rations. One has only to notice the very largely increased number of smoking chimneys to know for a certainty that coal is now taking the place of gas for cooking. Where coal-ranges are not in order, or are not in existence, paraffin oil is being used in oil cooking-stoves. That gas should not be wasted is quite a sensible view to take; but what gas is used should be made from coal alone as far as is possible.

A communal kitchen, run entirely by electricity, has recently been opened in the East-End of London. For such a wartime measure, one would have thought better sense would have prevailed, and the kitchen would have been run by gas from which vital products are obtained, and not by electricity from which none are procured. The Food Controller sealed it with his approval. Does this mean that other communal kitchens are to be run by electricity? One would have thought the Food Controller would have disapproved of electricity being used, considering that coal distillation is very instrumental in providing sulphate of ammonia as a valuable chemical manure to produce food as well as fuel oil for the Navy, to protect the food ships.

REFRACTORY MATERIALS.*

In view of the marked attention which refractory materials have received during the last year or two—owing to tardy realization of the important part they play in connection with our national industries—as compared with the apathy displayed previously, the author has hit on a favourable time for the publication of the book under notice. Even the fire which destroyed the printed sheets was not an unmitigated disadvantage, since it thus became possible to make use of the published results of many recent researches before the book was finally issued. The subjects dealt with cover an exceptionally wide range, including more or less full accounts of practically all the substances which can be legitimately classed as refractory materials. This in itself would make the work useful for reference.

Descriptions of processes with which the author is presumably familiar constitute an important feature of the book. Unfortunately, it seems necessary to exercise some caution in using it, as there are various and not infrequent evidences of haste or carelessness, which is particularly disappointing in association with an experienced writer like Mr. Searle. Thus, Veitsch is consistently misspelt Vietsch on pp. 111, 116, 117 (twice), and several other places; and Podzus is invariably given instead of Podszus (five or six times). Other misprints occur more frequently than is desirable; but ordinary misprints observed do not seem as a rule to be very serious. The same remark applies in the main to certain loose forms of expression which are met with here and there, as when, on p. 373, reference is made to a porcelain with "the felspar or other base low." The fault (whatever it may be) becomes more serious in cases such as that on pp. 122 and 123, where "ytterbia" is repeatedly substituted for "yttria," and on p. 4, where the formulæ of alumino-silicic acids attributed to Mellor have been so transformed that they have no intelligible meaning as they stand; the six different formulæ being practically reduced to identity.

Incidentally it may be noted that the hexite-pentite theory of W. & D. Asch, the brief account of which might induce readers to think it was generally adopted, is very far from being accepted as valid by the majority of experts. In this instance, the earnest student is placed in a position to judge for himself, as a full reference is given to another work in which the subject receives detailed treatment. It is a pity the practice of giving full references was not pursued systematically; for in cases like the alumino-silicic acids (above referred to) readers have no means of checking any mistakes, except through any knowledge acquired independently of the book itself. Such references to the original sources are too rarely given, and would be particularly helpful as regards recent work; they ought certainly to be added in any subsequent re-issue of the book. Even in the descriptions of processes, in the absence of some means of checking them, one cannot always feel absolute confidence—as in the method of casting glass pots referred to on p. 341, and the proportions of grog to fireclay (1 to 8) given for making saggers on p. 284. Evidence of a remarkable oversight occurs on p. 147, where fig. 40, represented as being Messrs. Whittaker's "New Era" brick press, is really a stiff-plastic machine; and the accompanying description, if it is intended to apply to the "New Era" press, scarcely does justice to it.

The statement on p. 179 as to "particles of iron sulphide (pyrites) which never give a red colour to the clay, but invariably show up as black or slagged spots, owing to the combination of the ferrous oxide with silica immediately the iron has parted with its sulphur," suggests abnormal behaviour, unless the supply of air were unduly restricted all through; and it can scarcely be that the particles of iron sulphide "never" get enough air.

In connection with siliceous materials, there is a reference (on p. 96) to silica bricks, for which "it is essential to use a quartzite composed largely of tridymite, or one in which the particles are cemented together with a natural cement." Again (on p. 97), it is stated that "some sands which consist of amorphous tridymite are quite satisfactory." It is not indicated where these tridymite sands and quartzites are to be obtained; and as regards the first statement, good silica bricks are made both in our own country and in America with materials quite different from those that are here prescribed.

In the final chapter, advice is offered concerning the selection and mode of application of refractory materials for various purposes—a feature which should have considerable value from a practical point of view. Following this are various standard specifications, including those of the Institution of Gas Engineers and the American Gas Institute.

Some 22 pages are devoted to the subject of retorts—almost exclusively those used for the distillation of coal. This is, of

* "Refractory Materials: Their Manufacture and Uses." By Alfred B. Searle. London: Charles Griffin & Co., Ltd. [Price, 18s. net.]

course, in addition to the rather full general consideration of the several raw materials. Single-piece retorts and segmental retorts are discussed, and the methods of making them by hand and by machinery from the different materials—viz., silica, bauxite (with fire-clay), graphite (with fire-clay), magnesia, silicon carbide (carborundum), chromite, and clay. The metal (iron) retorts sometimes used are mentioned in passing. The relative merits of British and German clay retorts are set out—materials, methods of making, &c., being compared; and suggestions are offered with a view to some possible further improvements of the home-made products.

With the reservations indicated, the work under review should prove very serviceable as a handy general guide to the present state of knowledge as regards the very important technical subjects of which it treats.

ATTITUDE OF THE GOVERNMENT TOWARDS THE GAS INDUSTRY.

By a Director of Several Gas Undertakings.

A strong feature of the numerous restrictions that have been directly or indirectly put upon our industry during the last three years is the arbitrary way in which they are inflicted, and the absence of any consideration as to the effect they will exercise on the financial and working conditions, on the value of the property and the rights of shareholders, and of the fact that all this will eventually filter down to the consumers of gas, and—at any rate in parts of the country where local industries largely depend upon the supply of gas—will affect industrial conditions in no unimportant a degree. Instances might be quoted of other notable industries in which, under the support of the Government, not only have pre-war profits been maintained, but excess has been earned. In dealing with the gas industry, however, they seem to have reflected the spirit of the old-time price agitator, and of his modern representatives who assume that the way to encourage a cheap and efficient supply of gas—an indispensable condition of which is the raising of capital on low terms—is to take away the profits and add to the working expenses.

Advances in the price of staple materials, or important restrictions on sales, are put forward without notice, or even made retrospective. Yet there are some who stigmatize similar action in raising the price of gas as high-handed and discreditable. The Government may abrogate existing contracts to a very important extent; but gas companies are told that the supply of gas is an established contract, the terms of which can only be altered by advance notice. There is no recognition of the fact that this may involve working at a serious loss for a period ranging from anything between three and six months. Further, many of these restrictions have the effect of increasing working expenses, and the unfortunate undertaking is thus called upon to pay for a losing game, and to burn the candle at both ends. While every item on the expenditure side is heavily handicapped by war conditions, and those of income are restricted, conditions of business in dealing with the consumers are to remain exactly as in normal times. It would be difficult to find a parallel. A housewife who has been accustomed to buy butter periodically does not find that the grocer recognizes an established contract, or liability to supply at the standing price in the absence of advance notice.

In the United States these matters are regarded in a different light. Maximum prices and other obligations are not under the control of a central authority, but are regulated by State Commissioners, and in some few of the larger cities by the local authorities. Occasionally a conflict arises between the two; but this is the exception, and, as a general rule, the State Commission holds the balance fairly, and cultivates a friendly understanding with the gas undertaking on the lines so successfully adopted in this country by the inspectors under the Alkali Works Acts. They have skilled advisers and undertake research work, so as to get accurate technical knowledge of the matters that are submitted to their judgment.

Recently, Mr. M'Adoo, the Secretary to the Treasury, addressed a letter to President Wilson, enclosing memoranda relating to public utility undertakings supplying heat, light, and power. This indicated the existence of grave apprehensions as to the adequacy of services and rates under existing conditions, and expressed the view that the largely increased cost of material and labour had affected them, as it had the public in general; and that the public requirements and the financial needs upon which such services depend, could not be met without special and united effort. Mr. M'Adoo proceeds to point out that it is obvious that every part of the industrial and economical life of the nation should be maintained at maximum strength, in order that each section may contribute to the fullest possible extent to the vigorous prosecution of the war. *Public utilities must not be permitted to become weakened.* It may be that, here and there, States and local authorities do not always appreciate the close connection between the *soundness and the efficiency of the local utility companies and the national strength and vigour*, and do not resort *with sufficient promptness* to the call for remedial measures. The public service utilities are an essential part of preparations for, and the successful prosecution of, the war; and the unfavourable tendencies revealed by the enclosures may most effectively be checked, wherever they are found to exist, and the needful relief obtained, by prompt action on the part of the authorities concerned. He concludes with the expression of an earnest hope that the President may feel justified in stating the conviction that the vital part represented by the public utility undertakings in the life and war-making energies of the nation should receive fair and just recognition by State and local authorities.

Within four days the President replied (one of our Government departments would have taken more like four months) to the effect that he had fully examined the papers enclosed, and entirely agreed with the views expressed in the letter—that everything reasonably possible should be done to maintain the public utilities at their *maximum efficiency*, and *he hoped* that State and local authorities would respond promptly to the necessities of the situation, and that the authorities concerned would be informed that such a course was desirable in the public interests.

I have italicized the parts of this extract to indicate the difference between public authoritative opinion in the United States and in Great Britain. The public utilities are there treated as being an integral part of the national enterprise. Here, if not ignored, they are made to encounter hostility as outsiders and Ishmaelites. In America, there are grateful consumers who recognize the maintenance of efficient public service under difficulties. Here, if gas undertakings get into the Law Courts, they receive no consideration, but are penalized on account of matters entirely beyond control. There is agreement so far as the general action is depreciated and each case must be considered on its merits. Sauce for the goose is also fit for the gander; and this argument might fairly apply to some of the restrictions instanced. But having run together so far, we find the marked divergency that in America President Wilson can find time to express strong approval of any prompt action, while in England the only remedy is the established procedure of application to the Board of Trade or to Parliament—a tedious process that may be extended over six months or more by hostile tactics of a factious nature, and that involve heavy legal expenses and a heavy draught on the management, at a time when ready money and superfluity of labour have almost entirely passed out of existence.

Yet it is not at all obvious that matters could not be greatly facilitated if a more marked disposition in favour of this course was in evidence, by Standing Orders on the lines of the Model Clauses attached to the Gas Works Clauses Act, 1871. We are not asking for action in respect to debatable matters or questions of opinion, but on incontrovertible facts that can be proved to the hilt from the published audited accounts.

The latest returns from America are to the effect that the reply of the President has exercised a powerful influence in the direction of securing prompt and fair consideration for petitions soliciting revision of existing obligations.

NEW USES OF FUEL GAS.

A paper dealing with this subject, also including some general remarks on the advantages of using gas for industrial purposes, even where the cost, as compared with other fuels, appeared prohibitive, was read by Mr. C. H. Kallstedt, the Industrial Salesman of the Northern Illinois Public Service Gas Company, at the meeting of the Illinois Gas Association. In comparison with solid or liquid fuels, many other items than the bare cost per British thermal unit should be taken into account. More work can be accomplished with less labour, and a clean reducing flame (so necessary in many heat treatments of metals) could be secured when desired, which was actually impracticable with oil or coal. There was no storage, freight charge, demurrage, unloading or handling, short and irregular deliveries, or disposal of residual waste. At present prices, however, gas can easily compete with other fuels on the basis of bare cost. The new uses described included asphalt melting for making shingles and roof sheeting; the manufacture of lubricants, consisting of a base of tallow or paraffin oils mixed with other ingredients; and various chemical manufacturing processes. A special advantage in heating tars, oils, &c., near or up to boiling point was that the temperature could be closely controlled, avoiding the chance of overheating and boiling over, with serious risk of fire, which was so great that 90 p.ct. of the roofing companies in the country were unable to effect satisfactory insurance on any terms. Considerable space was also devoted to various processes for treatment of iron and steel, for which gas had proved to be specially adaptable—such as the manufacture of tinned ware and cans of all kinds (whether from finished tinned plate or from black sheets with the tinning of the article as a final process), automobile manufacture, foundry core drying, and smith shop operations, tempering saws of all kinds, &c.

Output of Coal last Year.—Advance proofs of the report on Mines and Quarries for 1917 show that the output of coal was 248,473,119 tons, a decrease of 7,875,232 tons on 1916. For 1913 and 1914 the output was 287,411,869 and 265,643,030 tons respectively. Persons employed at the mines numbered 1,021,340, an increase of 23,277 on 1916, but a decrease of 106,550 on 1913. The rate of decrease on the pre-war figures in the output is about 13¾ p.ct.; while in the number of persons employed there are about 9¼ p.ct. less.

SOCIETY OF BRITISH GAS INDUSTRIES.

The Annual General Meeting was held last Thursday, at the Trocadero Restaurant, Piccadilly Circus, W. Mr. Percy F. Holmes, J.P., the Chairman of Council, presided during the transaction of the formal business. Later, the President (Sir Robert Hadfield, Bart., F.R.S.) occupied the chair, to which, before the close of the meeting, the Rt. Hon. Lord Moulton, K.C.B., G.B.E., F.R.S., the new President, succeeded.

The following was the formal business before the meeting:

Minutes of Last Year's Meetings.

The minutes of the last annual and autumn meetings were confirmed.

Letters of Regret.

The Secretary (Mr. Arthur Griffith) reported that letters of regret for absence had been received from Surgeon-General Sir Alfred Keogh, G.C.B., Mr. J. H. Balfour Browne, K.C., the Rt. Hon. H. E. Duke, K.C., M.P., Mr. H. E. Jones, the President of the Institution of Civil Engineers and of the National Gas Council, Mr. Thomas Berridge, Vice-President of the Institution of Gas Engineers, Prof. J. W. Cobb, and Messrs. John Bond, E. A. Harman, H. Kendrick, Robert Watson, J. H. Brearley, H. James Yates, and F. J. West. Also from many other members of the Society, as well as gas engineers, who were too busy on war work to attend.

Report of the Central Council.

The report of the Central Council was next presented.

In the first place, the report referred to the loss the Society had sustained by the deaths of Alderman John Miles and Mr. George Wilson. It then recorded the honours that had been conferred upon Sir Robert A. Hadfield, Bart., Sir Dugald Clerk, K.B.E., Sir Alfred Keogh, G.C.B., Sir W. H. Cowan, M.P., Lieut.-Col. W. R. Glover, D.S.O., and Mr. E. E. Cutler, M.B.E. Allusion was made to the strenuous times through which we are passing; and then were mentioned the several questions that have been engaging the attention of the Council. Among them, it was stated that—

The subject of refractory materials research still continues to engage the close attention of Sir Robert Hadfield (the President) and Mr. Albert Cliff (Chairman of the Fire-Clay Section); and, in connection with this matter, it is interesting to note that a Sub-Committee has been appointed to work in conjunction with Dr. J. W. Mellor, in order to investigate a proposed new method of manufacturing retorts by casting. Towards the preliminary expenses of the proposed Association of Refractory Research the Council have voted a contribution of £10; and the members of the Fire-Clay Section have subscribed £150 as the Society's contribution, which, in conjunction with an equal amount subscribed by the Institution of Gas Engineers, enabled the Government grant of £300 to be obtained.

The question of the life of gas-meters still occupies the attention of a Joint Committee of the Institution of Gas Engineers and the Society. Although this Joint Committee feel that matters progress very slowly, still the Council consider that they are to be congratulated on the progress they have made, especially under such trying circumstances.

One important matter which has arisen during the year, and is worthy of special note, is the question of the guarantee given by the makers with new and repaired meters. This guarantee has never been clearly defined, and has gradually grown until it has been claimed to cover practically every cause of failure whether or not under the control of the makers. Changes in the method of gas manufacture and distribution which have taken place in recent years have all tended to make this guarantee exceedingly onerous; and it was felt that the time had come for either a reduction in the period of guarantee or a limitation of its extent. The Council are pleased to report that, although this matter is still under discussion, there is every hope of a satisfactory arrangement being arrived at shortly.

Again, a report on the composition, calorific value, and pressure of gas has been prepared by the Council, at the request of the National Gas Council, for presentation to the Fuel Research Board, in conjunction with reports from the Institution of Gas Engineers and the British Commercial Gas Association. The importance of these questions cannot at the present time be over-estimated, as in the great reconstruction work of this country—industrial and domestic—cheap and yet good composition gas will be one of the supreme requisites. What such good gas would mean to all the members of the Society with the expansion of the gas industry that would follow is perfectly obvious. In fact, the interest of the Society in the matter is as immediate as that of the gas-supply industry itself.

To assist in meeting the expenses of the National Gas Council for the current year, the Society has made a further grant of £100.

The Ministry of Munitions requested the Society to act as the rationing body for materials required in the manufacture of burners, fittings, &c., for the whole of the United Kingdom; and the Council approved of Section VII. of the Society acting in this capacity.

The report also contained thanks to Sir Robert Hadfield, Bart., for his valuable services as President, and also for his generous offer of prizes for competition on a subject which will be announced later. With pleasure, the Council also announced that the Right Hon. Lord Moulton had accepted the presidency for the coming year.

The Chairman, in moving the adoption of the report, referred with regret to the losses of members by death. In addition to the two gentlemen mentioned by the Council, since the report was prepared Mr. J. P. Pickering—a very old member of the Society—had also passed away. The next item in the report was one of congratulation. Several members had received well-merited honours; and he (the Chairman) was sure that their fellow-members would wish them long life and prosperity to enjoy these honours. Various committees had been appointed from time to time, and had done good work. He was sure the efforts of these Committees would continue in the various directions mentioned in the report. The work of the National Gas Council still proceeded; and it was to be hoped that the advice the Society gave from time to time would prove of service. Finally, he should like to say how much the members appreciated the services Sir Robert Hadfield had given to their affairs during the term of his presidency, as well as of the tangible expression they had received from him of his deep interest in subjects pertaining to the gas industry. He was also voicing the feeling of the members when he said how much was their satisfaction at the honour Lord Moulton had done them in accepting the presidency for the ensuing year.

Mr. W. D. Helps seconded the motion; and it was unanimously carried.

Financial Statement and Subscriptions.

Mr. Thomas Glover (Edmonton) moved the adoption of the financial statement. He mentioned that, whereas the year started with a debit balance of £174, there was now a balance in hand. This, he thought, was largely due to the fact that the subscriptions were increased. They were, if he might say so, still standing at the trifling figure of five guineas. If the Society was going forward, and was to do better work, the subscriptions should be very much increased. If membership was not worth more than five guineas, it ought to be.

Mr. T. E. Upjohn seconded the motion, which was unanimously carried.

Office-Bearers.

The Chairman then announced the members elected to represent the various sections on the Central Council [see list below].

Mr. Thomas Glover (Edmonton) pointed out that the election had not been conducted in accordance with Rule 11. He was not objecting to any name in the list, but merely to the fact that the election had not been carried out in conformity with the rules.

Mr. R. J. Milbourne remarked that the matter had been discussed in Council that morning. It was quite understood there had been some oversight; but in future the rule would be adhered to.

The Chairman said he must accept the responsibility for a clerical error in the way the notices were sent out; but next year the rule would be complied with.

Mr. Glover formally proposed the confirmation of the election of the gentlemen named; and this was at once agreed to.

The Chairman, with the greatest pleasure, moved the election of Mr. Archibald P. Main as Chairman of the Council. He acknowledged how, as Vice-Chairman, Mr. Main had relieved him of much work in London during the year.

Mr. Cyril G. Davis seconded the motion, and it was very heartily passed.

Mr. Main, having acknowledged his election, moved the election of Mr. Samuel Cutler, jun., as Vice-Chairman.

Mr. H. M. Thornton seconded the resolution, which was cordially agreed to.

Mr. Cutler thanked the members for their confidence.

Mr. F. C. Tilley was next elected Hon. Treasurer, on the motion of Mr. F. J. Gould, seconded by Mr. Charles Clare.

The Hon. Sec. (Mr. Charles Clare) was re-elected on the proposition of Mr. John Bilbie, seconded by Alderman F. Templer Depree, J.P.

Moved by Mr. Cutler, and seconded by Mr. J. W. Scott, Mr. Holmes was appointed an Elective Member of the Council.

On the proposition of Mr. F. G. Cockey, seconded by Mr. C. A. Goodall, Messrs. F. Templer Depree and H. M. Thornton were re-appointed Elective Members of the Council.

Proposed by Mr. T. A. Braddock, and seconded by Mr. R. B. Hodgson, Messrs. Cash, Stone, & Co. were re-elected Auditors of the Society, at the same fee as last.

The list of office-bearers now stands as follows:

President:

The Right Hon. Lord Moulton, K.C.B., G.B.E., F.R.S.

Vice-Presidents:

Sir Dugald Clerk, K.B.E., F.R.S., Mr. Charles Clare, Mr. J. H. Balfour Browne, K.C., D.L., Colonel Arthur Smithells, F.R.S., Prof. Harold B. Dixon, Ph.D., F.R.S., Surgeon-General Sir Alfred Keogh, G.C.B., the Right Hon. H. E. Duke, K.C., M.P., and Sir Robert A. Hadfield, Bart., F.R.S.

Central Council:

Chairman: Archibald P. Main.

Vice-Chairman: Samuel Cutler, jun., Assoc.M.Inst.C.E.

Fred J. West	Representing Section		I.
T. V. Miles	,,	,,	II.
C. A. Goodall	,,	,,	III.
Joseph Clayton	,,	,,	IV.
F. G. Cockey	,,	,,	V.
Cyril G. Davis, M.I.Mech.E.	,,	,,	VI.
F. J. Gould	,,	,,	VII.
A. C. Beal	,,	,,	VIII.
John Bilbie, M.I.Mech.E.	,,	,,	IX.
Albert Cliff	,,	,,	X.
B. B. Waller	,,	,,	XI.
J. W. Scott	,,	,,	XII.

Elective Members: Alderman F. Templer Depree, J.P., Mr. H. M. Thornton, J.P., M.I.Mech.E., Mr. Percy F. Holmes, J.P., M.I.Mech.E.

Ex-officio Members: Mr. Charles Clare, *Honorary Secretary;* Mr. F. C. Tilley, *Honorary Treasurer.*

Secretary: Arthur L. Griffith, 46, Queen Victoria Street, E.C. 4.

Votes of Thanks.

The Chairman proposed a hearty vote of thanks to Mr. Clare (the Hon. Secretary), Mr. Braddock (the former Hon. Treasurer), and Mr. Griffith (the Secretary), who had all faithfully and well carried out the work that had fallen upon them. Mr. Clare and Mr. Braddock had given a considerable amount of time to the Secretary's and Treasurer's work respectively. No Society could have been better served. As to Mr. Griffith, he (the Chairman) did not know how he managed to

carry out all the duties that fell upon him in connection with the Society during these trying times.

Mr. CYRIL DAVIS seconded the motion, which was very heartily passed.

Mr. CLARE, Mr. BRADDOCK, and Mr. GRIFFITH individually acknowledged the vote—Mr. Clare, among his remarks, observing that time had proved the wisdom of the selection of Mr. Griffith as Secretary.

Mr. W. D. HELPS moved a vote of thanks to the Chairman and Council for their work during the year. In all that they had done, the members found heartiness and sincerity of purpose.

Mr. SAMUEL SPENCER seconded the motion, which was cordially adopted.

The CHAIRMAN, replying on behalf of himself and the Council, said to him personally it had been an extremely great pleasure to work on the Council. He had found that membership of the Society and work on the Council increased one's friendships, and personal associations were formed which would last a lifetime. The members of the Council had all done excellent work; but the Special Committees had had the bulk of it to do. In the new members of the Council, they had men who would give the same untiring effort as had those who were now retiring.

Mr. MAIN, called upon by the Chairman to supplement his remarks, said it was very good of the members to express their thanks in the manner they had done. The longer the Society continued in existence, the profounder must be the conviction that it had been formed to do a great work, and was doing a great work, and that, following the present crisis, it would still in the years to come have a greater work to do than ever it had even attempted to accomplish in the past. It was the commonest of commonplaces to say that, as the result of the present terrific struggle, not only this country, but the whole industrial world, was moving into a new orbit. It would never see the same again. The industrial conditions, and the relations of capital and labour, would be profoundly modified, and, he thought he was not optimistic in saying, enormously improved.

At this stage, the PRESIDENT (Sir ROBERT HADFIELD, Bart., F.R.S.) took the chair; Lord MOULTON occupying a seat at his side.

PRESIDENTIAL ADDRESS.

The PRESIDENT had prepared what will be a souvenir of his year of office. It is a book approaching one-hundred pages, and illustrated by excellent photographs and diagrams. It is a technical compilation on all sorts of matters directly and indirectly interesting to men engaged in engineering work, with prominence given to current topics of concern to men engaged in the gas industry. It was called the "Presidential Address," but it is something more, although it formed the basis by quotation for Sir Robert's address. In other columns [pp. 243-4] some extracts from it are given; it being impossible to publish the volume *in extenso*.

The PRESIDENT, during some asides, said he did not think the country would ever know, until after the war, how much it was indebted to Lord Moulton for the way he had worked to bring forward an enormous supply of high explosives. He warmly congratulated him upon the success of his department. There could be no greater satisfaction to a citizen of the Empire, whether peer or commoner, than to know that he and his work were held in great esteem. Lord Moulton had the satisfaction of knowing he was regarded with much appreciation for what he had done in helping to equip the Army and Navy for fighting the enemy. In connection with the subject of fuel research, the President remarked that a short time ago Prof. Bone went to Sheffield; and he had an opportunity of having a chat with him. Prof. Bone was prepared to do still more in this cause; and Sir George Beilby, Chairman of the Board of Fuel Research, and Sir Alfred Keogh, of the Imperial College of Science, were both willing for Prof. Bone to go round to the various cities, and be the means of trying to explain to the citizens the various ways by which fuel economy, which included gas, could be obtained. This was the true application of science to industry; for Prof. Bone possessed knowledge as an expert in fuel economy which was second to none. This he (Sir Robert) thought represented a great step in advance. They found their enemy was studying this matter. Several German authorities were taking it up; and he thought that this country should advance on the same lines. It would be a great advantage. Later on Sir Robert found an opportunity of congratulating Sir Dugald Clerk on the honour that had been conferred upon him. Referring to educational facilities, he was glad to see that the British Empire was now very well secure in this respect, if only proper use was made of the equipment—that was to say, if they only encouraged the local universities, and the central authorities would give them powder and shot with which to work. The war had taught them that they had hitherto been too parsimonious. They had not spent enough money on education. If they had only spent on it one-hundredth part, or one-thousandth part, of the money the war had cost the country, it would have been better off to-day. However, in the future, there were two things they must have, and they were the better housing of the poorer people and better education. By particular attention to these two divisions in our lives, great advance would be made by the Empire. He also alluded to the United Engineering Societies' Building in New York, in which nearly 60,000 members had their headquarters, and adjoining was an Engineers' Club, so that members could step from the one to the other building, which meant a saving of time. In his opinion, it was a very important thing that various institutions should be aggregated in this way. There was too much waste of time. In London, for example, they had the building of the Institution of Civil Engineers and that of the Institution of Mechanical Engineers. But outside them, they had nothing that was worth talking about. They should bring the various secrets of technical knowledge together. He hoped some day to see something of the same kind in this country. It could not, of course, be done yet; but he believed in ventilating the subject, because by this means they could improve knowledge of it, and so make advance.

Sir DUGALD CLERK proposed a hearty vote of thanks to the President for his address. He said that no previous President had given an address approaching in completeness and get-up the one prepared by Sir Robert. It contained a mass of information that must have meant an enormous amount of work. He (Sir Dugald) often wondered how the President got together so much information, of which this was an excellent example. When in New York, he himself was impressed with the fact of how central and convenient their engineering arrangements were. In this respect, he thought that the engineering societies in this country might take an example from America.

Colonel ARTHUR SMITHELLS, F.R.S., with very great pleasure seconded the motion. It was a magnificent compliment to the Society to produce an address of the character of the one Sir Robert had laid before them. It obviously abounded in endless topics for discussion and reflection; and it raised questions of enormous importance not only to the gas industry as a body, but to the nation as a whole. He (Colonel Smithells) might perhaps, in virtue of his calling in times of peace—not his present calling, which, by the irony of fate, was anti-gas—refer to one of the topics to which Sir Robert had alluded in the course of his comments—the incidence of University education on industry. It was very heartening to people like himself, who had tried for a lifetime to bring University education into relation with the needs of the industrial community, to hear such views as had been expressed by Sir Robert. Their President had great hopes and expectations as to the future of the Universities of this country; and he made great demands. He (Prof. Smithells) shared his hopes and expectations; and he would also associate himself with Sir Robert in making great demands. But he would like to say this, that the need of the Universities of the country was sympathy from the leaders of industry. This was infinitely more important to them than material support, because, once the sympathy was secured, there was not the least doubt all the rest would follow by mutual understanding. It was of the utmost consequence that these two classes of the community should not stand apart—the industrialists and those of the learned world. They must be brought together, and made to co-operate for the infusing into the industrial life of the springs of knowledge without which it could never be brought to the standard required, if this country was to hold its place in the competition of the world. He was not a great enthusiast for Government support or endowment; and he would often be heard during the coming time raising a warning note against expecting or desiring that the Government should take on hand the support of University education in the country. Government support was always followed by Government control. This was inevitable; and nothing, in his opinion, would be more disastrous for the educational life of the country than that the Universities should be dominated by a central Governmental authority. At the present time, they had an example before their eyes which ought to be a great warning. He felt quite confident that they might count upon the multiplication of that rare kind of man who was personified in their President. He could not say how much the Leeds University had been indebted to men of his kind. Sir Robert had referred to the Sheffield University; but he had not said one thing. He (Prof. Smithell) knew how much the hearty and enthusiastic support of Sir Robert had meant to the University of Sheffield.

The motion was cordially carried.

The PRESIDENT thanked the speakers very heartily for their kind words and the members for their endorsement. He always felt a great deal of sympathy with the smaller societies, as they were apt to be overlooked. Very often it was the smaller societies that were doing the most and the best work. He congratulated the members upon the way in which they had helped the country in the present crisis. Whatever he could do for the Society in the future would be a great pleasure.

LORD MOULTON IN THE CHAIR.

The PRESIDENT said his next duty was a most pleasing one. It was to induct the Rt. Hon. Lord Moulton into the chair. It was unnecessary for him to say anything about Lord Moulton. His was a household name; and reference had been made in the addrees to his great work. The Society was to be congratulated on having obtained him as their President. He knew that his Lordship would watch over the interests of the Society; and in every way do his best to extend the useful sphere of its most useful work.

Lord MOULTON took the chair amid applause.

The PRESIDENT at once thanked the members most heartily for the honour they had done him in asking him to become President of the Society. It was a great pleasure for him to be brought into such intimate contact with those trades that advanced the industrial position of the country with a due regard and a proper loyalty to the scientific side. It was through such societies that they might rationally hope for progress in the future at a rate which was worthy this country. He felt the responsibility of becoming President in succession to Sir Robert. He confessed that his address (which he had had the opportunity of mostly reading) filled him with terror; and he thought the greatest kindness he could do those who would succeed him in this office was to say plainly that he declined to establish the precedent of a President giving an address, even after his year of office, of the comprehensive, and he might say encyclopædic, character of this address, and got up with such a wonderful sympathy with the writer, because the tables and the diagrams were all that could be desired to make not only intelligible but comprehensive the great body of material contained in it. How Sir Robert got time to do work of such an elaborate character, he (Lord Moulton) did not know. He could not help thinking he must shirk all the rest of his duties. [Laughter.] However, Sir Robert had established for himself a reputation on both the industrial and scientific sides which was much to be envied. He did not know of any name which stood higher in the development of metallurgical science on those sides which were most important to mankind. Manganese steel, of which Sir Robert had spoken, he (Lord Moulton) had known for very many years. It was now many years ago since Sir Robert gave him a bit of steel which was magnetic at one end and not at the other; and having, of course, solved the problem of magnetism in iron so long ago, he came to the conclusion that it was an absolute fake. [Laughter.] But it had persevered with its fraudulent conduct to this day. The members had had the very great privilege and pleasure of having Sir Robert as

their President; and they had reaped the reward of it that day, or they would reap it when they read the address. Even, perhaps, more than that, it was a great thing for the Society to know it had his continued friendship, and that, whenever it had to call upon him for assistance, the call would not be in vain. He did not know whether it would be possible for him (Lord Moulton) to shepherd his flock down to Sheffield; but it would be a great delight to the members and himself if he could do so. He did not propose to address the members that day. The work of the Society was too solid and too serious to be dealt with in a few trivial words. Nothing had impressed him more during the years of the war, in which he had been in closer contact than ever before with the industrial and productive world of Great Britain, than the vital part played by the gas industry. There had been developments in all directions in industrial science. Sometimes it had looked as though gas was passed by; but as they examined more and more into the matter of treating fuel, the importance of its gaseous form came to the front. But for gas the department over which he had the privilege of presiding would have been in despair. It was not only that it provided materials for explosives, for dyes, and for modern chemicals, but that, right through the problem of the use of fuel, gas—its production, its composition, and the mode of utilizing it—went forward as one of the biggest problems of civilization. Civilization really was based on the consumption of fuel. If they could imagine their coal supplies failing, the history of the next century would be a return to absolute barbarism. In the problem of the economy of coal, everything that belonged to gas stood in the first rank. The Society represented not the production of gas, not the mere consumption of gas, but the means of applying it to all the varied human wants which it had got to satisfy, and that was a very noble section of industrial work. This was not a subject to be treated lightly in a few words. He could now only say he esteemed very highly the work that belonged to the members of the Society, and that he trusted during his year of office, if there was anything he could do to increase the prosperity of the Society, he would be found doing it. And he trusted also that when the time came that he should have arrived at the happy position of Sir Robert Hadfield, of having got out of the chair [laughter], he should be able to congratulate the members upon the dark times having overpast, and upon being able to look forward to that to which all civilized nations ought to be able to look forward—a time when they could develop the powers of the nation, without fear, and in an unbroken peace. [Applause.]

The President, members, and visitors—of whom there were a large number—subsequently took tea together.

MIDLAND JUNIOR GAS ASSOCIATION.

Annual General Meeting and Visit to the Birmingham Gas Department Industrial Research Laboratories.

The Annual General Meeting of the Association was held on Saturday last, when a visit was also paid to the Birmingham Gas Department Industrial Research Laboratories at the Council, House and the Windsor Street Works. About 35 members. together with the President (Mr. R. G. Marsh) and Mr. W. G. S. Cranmer, the Hon. Secretary of the Midland Association of Gas Engineers and Managers, assembled at 3.30 p.m. at the Windsor Street Gas-Works, where an inspection was made of the foundry and shops for heat treatment and hardening.

Under the guidance of Mr. C. M. Walter, B.Sc. (Eng.), the Engineer-in-Charge, and Mr. V. E. Green, the Assistant Engineer, several furnaces were seen in operation and others in progress of construction; furnishing evidence of the magnitude and scope of the work in hand.

The plant covers a floor space of about 1700 sq. ft., and enables manufacturers to carry out on a full working scale any tests they may require in connection with annealing, carburizing, re-heating and quenching, normalizing, hardening and tempering of fine tools, gauges, cutters, beds and dies, the heat-treatment of high-speed and alloy steels, annealing of cast iron and the manufacture of malleable castings, the melting of brass, bronze, gun-metal, white metals, aluminium, and aluminium alloys. A large amount of work of an investigational character for manufacturers has been carried out already in these shops; and in some instances several tons of work have been dealt with in order to get results comparable with those which would be obtained when working on a full practical scale on their own premises.

The party then proceeded to the Council House, where tea was provided in the dining-room.

After tea, a lengthy inspection was made of the splendidly-equipped laboratories at the Council House, which have been established by the authority of the City Council, and have been actively engaged for twelve months in research work for the assistance of various manufacturing firms. The application of scientific knowledge in industry was never more necessary than at the present time, when efforts are being made to capture trade hitherto in the hands of the enemy. The work carried out in these laboratories is of the greatest possible variety, and deals not only with the use of gas, but the composition of metals, and heat treatment of metals of all kinds; also physical and mechanical testing, for which plant has been erected which would bear comparison with any in the country. Research work relating to electrical appliances, glassware, and problems which arise from time to time in the manufacture of articles of non-ferrous and ferrous metals can be dealt with in a very complete manner.

A considerable amount of special investigation work has also been carried out with the aid of the photo-micrographical apparatus which has been installed for the examination of steels, brasses, bronzes, and other alloys; and the members were greatly interested in hearing from Mr. Walter how great a saving in time, in the examination of any particular metal, is effected by the use of this apparatus. The laboratories also include a chemical and analytical laboratory for ordinary and research work of this nature. The members were shown actual tests on most of the machines for testing the physical properties of metals and alloys, including a 25-ton combined tensile, bending, torsion, and shearing machine, which is of the simple lever variety, with a sliding poise, having a total weight of a ton. A stress is applied to the specimen through screw gearing operated by electric motor; the latter being arranged for running over a wide range of speed, necessitating a special switchboard equipment. The tensile machine is also fitted with apparatus for automatically drawing a stress strain diagram. Other physical testing machines include a Brinell hardness testing machine, an Izod impact testing machine, and a complete outfit for conducting tests on cements.

The equipment of the laboratories also comprises a very complete set of carefully standardized electrical instruments, including reflecting galvanometers, potentiometers, standard bridges, and resistances, for use in connection with the calibration of temperature measuring apparatus and the standardizing and testing of electrical instruments, including pressure and current measuring meters, watt meters, watt-hour meters and ampere-hour meters, and at the same time is employed in connection with the determination of the melting points of metals and alloys, and also for determining the critical points of steels.

A set of small machine tools and grinding machines, for the purpose of keeping the apparatus in good repair and for the preparation of specimens and construction of laboratory tools and fittings, has been installed also.

Vote of Thanks.

At the conclusion of the visit of inspection, the members adjourned to the Reading Room.

The President, after welcoming Mr. W. G. S. Cranmer, proposed a very hearty vote of thanks to Mr. Walter and Mr. Green for making the visit so extremely interesting and instructive.

Mr. Cranmer, in seconding the vote, remarked on the progressive nature of the work carried on by the Research Laboratories. He said that undoubtedly gas had a great future before it for heating purposes, and it was a duty to adapt oneself to modern requirements.

Mr. Walter, replying to the vote of thanks, said they had been only too pleased to have the members visit the laboratories, and were glad the visit had proved interesting. In reference to the future of gas for heating, when the gas-furnace had been developed as far as possible, they must not overlook the coke-furnace. It would be wise to develop the latter to the greatest extent, as they had to aim at recommending to manufacturers the particular form of fuel most economical for the job, and not push gas only. The gas-furnace had an enormous field of application.

The Business Meeting.

The formal business of the annual general meeting was then proceeded with. After the minutes,

The Hon. Secretary (Mr. W. J. Pickering) presented the annual report and balance-sheet for the session. The report stated that at least 41 of the ordinary members are devoting their energies to military duties. Two new honorary members were added to the roll during the session, and 20 ordinary members—the total now standing at 191. The new honorary members are Mr. S. R. Barrett, Fittings Superintendent to the Birmingham Corporation Gas Department, and Mr. A. W. Smith, the recently appointed Secretary to the department—to whom heartiest congratulations were offered. The balance-sheet showed cash in hand and at the bank amounting to £16 15s. 6d.

The report and balance-sheet were received, on the proposition of Mr. V. E. Green, seconded by Mr. Harold Jones.

A vote of thanks to the Hon. Auditor (Mr. Walter Timbrell) was duly accorded for his services.

New Junior Vice-President.

The President announced that the Council had elected Mr. Harold Jones (Stourbridge) as new Junior Vice-President, and read a letter from Mr. Jones in which he expressed his willingness to accept the office.

Resignation of the Hon. Secretary.

The President then mentioned that Mr. Pickering had tendered his resignation as Hon. Secretary, owing to pressure of work, and paid a tribute to his services for the Association during seven sessions.

A hearty vote of thanks, in appreciation of the services which Mr. Pickering had rendered the Association during his period of office, was warmly accorded.

The Hon. Secretary, in replying to the vote of thanks, said that his resignation did not imply in the least any lessening of interest on his part in their affairs. He would remain as keenly interested as ever in the welfare of the Association—of which he had been a member from its commencement—and the cause of education generally among the juniors.

The New Hon. Secretary.

Mr. Pickering announced that Mr. H. W. Dean, of the Birmingham Chemical Staff, had been nominated as the new Hon. Secretary, and from personal knowledge of Mr. Dean he could assure the members that he would carry out efficiently the duties of the office.

No other nomination having been received, the President declared Mr. Dean duly elected.

On the proposition of Mr. W. G. S. Cranmer, a vote of thanks was accorded to the President for his kindness in arranging for tea, which all the members had greatly appreciated.

SIR ROBERT HADFIELD ON CURRENT TECHNICAL TOPICS.

[Extracts from a Presidential Address Prepared for Last Week's Meeting of the Society of British Gas Industries.]

INTRODUCTION.

In the writer's short address last April, he thanked you for the honour you had conferred upon him in electing him as your President; and though great pressure of war-work has prevented his being able to devote as much time or attention to the Society as he would have liked, it has been a great pleasure to be associated with the Society of British Gas Industries, which is doing such excellent work in the gas world. The writer is delighted to find that Lord Moulton, whose great efforts for our country are recognized on every hand, is going to take the Presidential Chair for the coming year; and he congratulates the Society upon having obtained the help of one who is so eminent, not only in scientific and legal attainments, but in the practical application of science to industry.

As the writer stated last year, the country is greatly indebted to the gas engineer in this time of war stress. Your activities have been immense during the last twelve months; and you are to be heartily complimented upon the services you have so ably rendered to the State in its hour of need.

The writer has been much struck by the excellent co-ordination between the different Gas Associations in this country—an example which might well be copied by Technical Societies in other lines of work. This was specially brought out at an interesting gathering he attended, at which were represented the Institution of Gas Engineers, the British Commercial Gas Association, the Gas Companies' Protection Association, and the Society of British Gas Industries. The meeting was most ably presided over by Mr. Harry E. Jones, the President of the National Gas Council, who also occupies the honourable position this year (on which we heartily congratulate him) of President of our premier Technical Institution—the Institution of Civil Engineers.

The writer takes this opportunity on your behalf of offering congratulations to the latter Institution, which last month commemorated its foundation in 1818. An excellent account of the work done during the hundred years it has been in existence has been prepared by its able Secretary, Dr. J. H. Tudsbery, giving a record of its origin and progress. Long may it flourish! Its first meeting was held on Jan. 2, 1818, at the Kendal Coffee House, in Fleet Street. In the course of an address to those who then met, Mr. Henry Robinson Palmer set forth the need at that time for a source of information or instruction for persons practising civil engineering, and pointed out in scholarly terms the advantages to be derived from recorded experience and the interchange of opinion upon questions which involve the application of scientific principles to the circumstances found in practice. He described the engineer as a mediator between the philosopher and the working mechanic, and showed a just appreciation of the mechanic's part in the realization of the engineer's ideas and designs. Mr. Palmer's proposals were adopted by the meeting, and the formation of the Institution was resolved upon for the object (as defined by the founders) of "facilitating the acquirement of knowledge necessary in the civil engineering profession, and for promoting mechanical philosophy."

It is interesting to note that a memorial to Mr. Palmer exists in the Palmer Scholarship, which is in the award of the Council, and is tenable at the University of Cambridge. The first paper presented to the Institution was that by Mr. Joshua Field, on April 27, 1819, on "Canal Locks." Maudslay, Rendel, Robert Stephenson, Whitworth, Penn, Brunel, Hawksley, Hawkshaw, Armstrong, Fowler, Kelvin, Baker, Telford, and Wolfe Barry are some, among others, whose names were household words in the past—also including its much revered Secretary, Mr. James Forrest, who occupied this post from the year 1860 until 1896, followed by the present able Secretary, Dr. J. H. Tudsbery.

FUEL RESEARCH.

The first section deals with fuel; the President remarking that the Society is naturally interested in the important subject of coal, its supplies and uses; and the members are probably aware that a Special Fuel Economy Committee was formed some time ago by the British Association for the Advancement of Science—this work being originated by Prof. W. A. Bone, F.R.S. Undoubtedly the report of this Committee showed the necessity of at once dealing with this question of the conservation of the fuel of the country. It has been stated to the writer by one greatly interested in the gas industry that the work of this organization, with its "detached" point of approach, might be continued with benefit to the public interest, and would provide means for the free exchange and discussion of new ideas in fuel economy.

Quite recently the Fuel Research Board of the Department of Scientific and Industrial Research has been started. This represents the fuel interests of the country, and is ably presided over by Sir George Beilby, F.R.S.; the other members being the Hon. Sir Charles A. Parsons, K.C.B., F.R.S., Sir Richard Redmayne, K.C.B., and Sir Richard Threlfall, K.B.E., F.R.S. Prof. Bone has been appointed Consultant to the new Board. He was the first holder of the Livesey Chair at the Leeds University, and the originator of the Bonecourt system of surface combustion, which is well known. Prof. Bone has for several years been carrying out excellent research and educational work at the special Fuel Laboratory at South Kensington. His vigorous advocacy of fuel economy of late years has been of great benefit to the country; and his association with the new Board is a happy augury of its success. His valuable series of lectures to the Royal Institution in January and February, 1916, on "Fuel Economy and the Utilization of Coal,"* should be read by all interested.

An organization similar to our own Board of Fuel Research has been formed in America, known as the United States Fuel Administration, at Washington (D.C.), of which Mr. P. B. Moyes is Director of Conservation. In Germany, under the auspices of the Kaiser Wilhelm Society, an Institute has been formed for Coal Research, of which the Director is Dr. Franz Fischer.

A number of statistics follow on the subject of the output and consumption of coal; and some pages on coal economy include an illustrated description of a semi-gas-fired continuous billet heating furnace on the "Wincott" system, as used by Messrs. Hadfields, Ltd.

COMPARISON OF COAL, GAS, AND ELECTRICITY.

The metallurgist who wants to heat or melt his steel cannot, says the President, afford to pay the price of town gas, and must have a cheaper source of supply. The question has been discussed by Mr. G. Helps, of Nuneaton. He states that the actual calorific value of fuel is really of quite small importance. Assuming that one has the same number of thermal units, it is immaterial whether the heat is obtained from a gas of high calorific value (say, 650 B.Th.U.) or one of lower value (say, 350 B.Th.U). It is obvious, of course, that in the second case a larger volume of gas is required to make the two quantities of heat equal. Under suitable conditions of combustion, Mr. Helps asserts that the gas of lower calorific value will give the better results.

Without offering any opinion regarding this statement, it would appear that the subject is worth thorough investigation. It must not be forgotten that electrical heating is coming rapidly to the front. Whether it can compete with gas remains to be seen. In one case, we have coal burnt in a boiler, and the heat energy transferred to steam energy; and this in turn drives the modern and highly efficient turbine plant, converting mechanical into electrical energy, which is cheaply transmitted over long distances. In the other case, the coal is turned into gas by producer, retort, or other system, one disadvantage of which is that the consumer cannot readily establish a gas plant as compared with a plant for producing electrical energy, which is also more easily and cheaply distributed.

When speaking of elecrical heating, it should be borne in mind that theoretically 1 K.W.H. will heat 20 lbs. of iron up to about 900° C., and 112 K.W.H. will heat 1 ton of steel to the same temperature. This, at (say) 0·40d. per unit, means only 3s. 8d. per ton, assuming all thermal losses can be prevented, which, of course, they cannot be. Still, the gas engineer has to bear this figure in mind, as apparently 1 ton of iron or steel can be heated to the same temperature by the expenditure of about 850 c.ft. of gas, assuming the calorific power of the gas used is about 450 B.Th.U. per cubic foot.

The writer is indebted to Prof. J. A. Fleming, F.R.S., for the following data on the above subject, which will probably be of interest:

To heat 1 lb. of water through 1° C. requires 1404 ft. lbs.
1 K.W.H. = 3,600,000 joules = 2,654,280 ft. lbs.

hence 1 K.W.H. $= \frac{2,654,000}{1404} = 1890$ water-lb. °C.

The specific heat of iron $= 0{\cdot}11 = \frac{1}{9}$,

Hence 1 K.W.H. will raise 17 lbs. of iron through 1000° C., or 1 K.W.H. will raise 20 lbs. of iron from 15° to 900° C., provided all thermal losses could be prevented.

From the above, it will be seen that the cost of heating 1 ton of iron with electrical energy at (say) 0·3d. per unit would be about 2s. 9d.; at 0·5d. per unit, 4s. 6d.; and at 1d. per unit, 9s. While this does not allow for thermal losses, it is a useful basis for comparison of cost; and from experience it can be ascertained what is the cost of these losses. By proper arrangement of plant, they can be brought down to reasonable and probably quite small limits.

The writer is indebted to Prof. W. A. Bone for the following information. In this comparison, he has based the prices for coal, gas, and electricity on those charged to householders for domestic heating purposes. All those interested should see his valuable new work on "Coal and its Scientific Uses."

Comparing the first cost of energy units in the form (1) of a good house coal of (say) 13,500 B.Th.U. per lb. at 30s. per ton, (2) of gas of 500 B.Th.U. per c.ft. at 2s. 6d. per 1000 c.ft., and (3) of electricity at 1d. per unit, £1 sterling will purchase the possibility of developing the following quantities of heat:

(1)	In the form of coal	20,000,000 B.Th.U.
(2)	,, gas	4,000,000 ,,
(3)	,, electricity. . .	825,000 ,,

These figures, however, do not represent the relative costs of the energy actually utilized in heating apartments or for cooking purposes, because a much greater proportion of the heat developed by the combustion of gas is utilized than by the combustion of coal; and the proportionate loss in the case of electricity is the least of all. The percentage losses in the three cases may be

* See "Journal," Vol. CXXXIII., pp. 206, 253, 305.

considered as approximately not less than 60 in the case of coal, about 20 in the case of gas, and not more than 10 in the case of electricity. Hence, for the expenditure of £1 sterling, the following number of "utilized" heat units would probably be obtained:

(1) Coal	8,000,000
(2) Gas	3,200,000
(3) Electricity	750,000

FUTURE SOURCES OF ENERGY.

Note is made of the development that is taking place in the use of pulverized coal; and its advantages are summarized. There are also figures relating to the bye-products of coal, with a chart showing what is obtainable from 100 metric tons of coal.

In a recent lecture by Prof. F. W. Burstall, of Birmingham University, on the "Transformation of Energy," he dealt with the fuel question in a very able manner.

As against about an annual output of coal in 1913, based upon good estimates, of 1400 million tons, the production of crude oil was about 60 million tons, and of this only 5 p.ct. was light spirit. In the earth's crust there is only a sufficient supply of crude oil, so Prof. Burstall thinks, to maintain the present requirements of petrol for about thirty years. Many scientists have been working at the problem, and benzol has formed a useful substitute; but the supply of this depends upon the amount of coal available, which is not unlimited.

Prof. Burstall, however, believes that, while certain alternatives might be usefully employed, they would only be partially effective. To obtain an entirely new source of supply, he points out that we must go to the sun, which is the ultimate source of all the energy in the earth. In order to do this, he suggests the use of alcohol, which forms a practically ideal fuel, but which will have to be produced in immense quantities, and at a much cheaper cost than is now possible. Alcohol can be easily produced from starch, which up to the present has been manufactured mainly for food and domestic purposes. It will be necessary to find some plant which is luxuriant in growth, and which will produce starch in large quantities. Such a plant, he believes, exists in Australia, in the shape of the cactus. He thinks that experiments in this direction might be conducted with advantage. But, in any case, it is incumbent upon us to learn to do all we can to store-up and utilize the vast amount of solar energy which now appears to be wasted day after day.

This seems to be a valuable suggestion, and will probably have a practical outcome in the future.

SUGGESTIONS BY SIR ARTHUR DUCKHAM, K.C.B.

Then comes the second section, dealing with gas; and in this connection there are (in addition to a good picture of Murdoch as a frontispiece) portraits of the late Sir Corbet Woodall and Sir George Livesey, Mr. Harry E. Jones, Sir Dugald Clerk, F.R.S., and the Rt. Hon. Lord Moulton, P.C., F.R.S. After quoting facts to illustrate the growth of the gas industry, the President brings to notice, as follows, some suggestions that have been put forward by Sir Arthur Duckham, K.C.B.

In the first place Sir Arthur states that, in his opinion, the great point for all gas undertakings and all industries relating to the manufacture and use of gas, is to make immediate recommendations for the establishment of a uniform calorific standard for the gas supply throughout the country. This standard should be one economical both to the producer and the user; and he suggests that it should be between 450 and 500 B.Th.U. net. This is the most important point in need of settlement. Those consuming gas in large quantities would naturally like to see the standard fixed at a figure as high as possible—certainly not below 500 B.Th.U., preferably to go up to 600 B.Th.U. under post-war conditions.

It is, of course, open to argument whether the B.Th.U. should be standardized at so low a figure as 450 to 500. Under pre-war conditions, Sheffield gas was 650 B.Th.U.; but after the war started, the Board of Trade sanctioned the reduction to 500 as a minimum. For many weeks, however, owing to the great pressure of war work, those in Sheffield have been glad to get gas round about even 400 B.Th.U. It is not economical to have poor gas; for not only have the pipes and connections to be enlarged throughout the whole system—that is, unless it is delivered at a much higher pressure—but the inert gases have to be heated, and consequently carry away large quantities of heat. In this respect it must be borne in mind that there is the "Pleno" gas argument before the gas industry; but the latter can hardly be discussed in an address of this nature.

The second point is the question of obtaining a larger output of gas by steaming vertical retorts. This was commenced by the Dessau Company in Germany, and was introduced in order to prevent the bottom of the retorts from overheating during the last periods of carbonization. Many experiments have recently been made with various types of vertical retorts in this country, with very good results; and Sir Arthur Duckham thinks that attention should be strongly drawn to this important development, and all users of vertical retorts pressed to carry on the work. Emphasis should be laid on the use of superheated steam.

Another point of great importance is that of the closer co-operation of manufacturers in order to obtain standardization of plant for producing and using gas. While believing in healthy competition, after the war we must look to economy in production as one of the chief means of meeting the huge liabilities imposed on us by the war. Great economies could be effected if manufacturers would agree to the making of standard types at different works, and to free interchange of knowledge and experience.

Sir Arthur Duckham says that it seems to him lighting will form the least important part of the supply of either gas or electricity. Household lighting will more and more turn to electricity as the price is reduced; but power essentially will be the sphere of electricity, and heating the sphere of gas. Solid fuel should be as far as possible eliminated—thus saving dirt, road transport, &c. The time has now come when electrical development in this country is being discussed; and Sir Arthur adds that he feels certain this time should not be allowed to pass without strenuous efforts being made to combine the interests of gas and electrical undertakings, in order that the greatest use may be made of the coal which forms the basis of all light, heat, and power supplies. Finally, and thinking chiefly of the consumer, it is advisable that there should not be a monopoly in any district. At present it is not possible, if unreasonable charges are made, to go to another source. Of course, if the regulations were of such a nature as to ensure gas of very high quality being always supplied, then the consumer would be pretty well protected; and it is probably in this direction we must look for more improvement.

A PRIZE OFFERED.

After dealing with the action of flame in furnaces, the President says that recently Mr. W. A. Tookey voiced the need of a flame-temperature indicator. It occurred to the President that possibly a prize would stimulate and raise interest on this or some other subject—for example, the best paper on "Fuel Economy," whether as regards lighting, heating, or melting, or any other suitable subject. To show, as President, that, though not directly concerned as a gas engineer, he is all the same much interested in the work of the Society, he suggested to the Council that he would be glad to offer a prize of £150, and hoped this would be acceptable, and prove of service. Through Sir Dugald Clerk, K.B.E. (Past President), they have since informed him that they accept the offer; the decision regarding the competition and the subjects to be dealt with being left in the hands of the Society. The President suggests that, while the Council should take the lead in the matter, each of the sections interested in the gas industry might be willing to inform their members that such a prize is open to competition, and be also agreeable to assist and co-operate in its award.

The third section is on the subject of fuel and electrical power consumption, the fourth on metallurgy (with charts showing the principal melting and freezing points and the heat conductivity of refractory bricks), the fifth with education, the sixth with commerce, the seventh with patents, and the eighth with the United Engineering Societies Building in New York, and the application of the scheme to this country.

CONCLUSION.

In conclusion, the President says he trusts he has been able to give some new aspects and facts relating to the industry in which the Society is concerned. In these days of ever-widening interests, it is not possible to present a statement of a brief nature without omitting important points. Besides, the ramifications of the gas engineer are certainly very wide and his interests most varied. The gradual accumulation of facts is of the greatest benefit to mankind; but if we are at times inclined to think we have reached the height of human knowledge, let us remember the wise words of the late Lord Salisbury, no less a Philosopher than a Statesman: "We live in a small bright oasis of knowledge, surrounded on all sides by a vast unexplored region of impenetrable mystery; and from age to age the strenuous labour of successive generations wins a small strip from the desert, and pushes forward the boundary of knowledge."

SCOTTISH JUNIOR GAS ASSOCIATION.

EASTERN DISTRICT.

The Annual General Meeting of the Association was held in the Heriot Watt College, Edinburgh, on Saturday.

In the Council's report, it was intimated that five new members had been added to the roll—one honorary member, and four ordinary ones. The balance-sheet was submitted, and showed the financial position to be fairly satisfactory. There are now 22 members serving with the Forces; and these members all pay complimentary subscriptions. A suggestion was made that the members should pay a levy of 1s. to wipe out the debit balance. Another suggestion imposing a penalty of 25 p.ct. on members whose subscriptions are not paid by Dec. 31 was withdrawn.

The following office bearers were elected:

President.—R. Waddell, of Polmont.

Vice-President.—L. Farquhar, of Alloa.

Council.—Messrs. Wilson, Gourlay, Letham, and Moyes.

A discussion on the selling of gas was introduced by Mr. J. J. Scott (Lower Largo), who suggested that they should sell on the 100 c.ft. basis. He pointed out that electricity is sold at so much per unit. Several members took part in the discussion.

Yorkshire Junior Gas Association.—There will be a meeting of the Association next Saturday afternoon, at the Thornton Road Gas-Works, Bradford, when a paper will be read by Mr. E. Gillett, entitled "Repairs and Maintenance Costs of a Two Million C.Ft. Per Day Glover-West Vertical Retort Installation."

TRANSMISSION OF HEAT.

By J. Dougill, M.Sc., A.I.C.

[A Paper Read before the Yorkshire Junior Gas Association.]

In designing new plant, or in altering old, it is often useful to be able to estimate with some degree of accuracy what cooling or heating surfaces will be required, what temperatures may reasonably be expected, &c.; and the following figures have been found useful in this respect. As is well known, there are three possible ways by which heat may be transmitted—convection, radiation, and conduction; and I propose to deal with each separately.

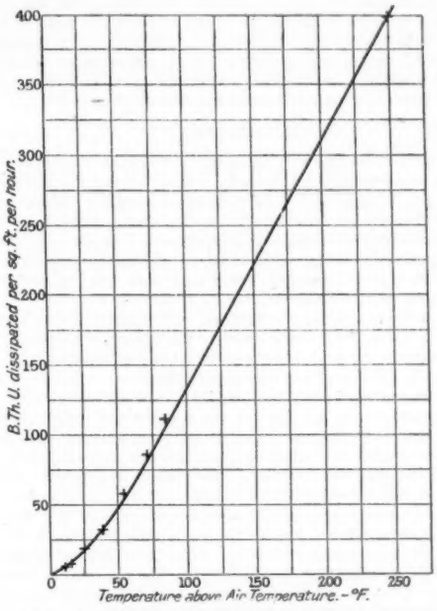
Convection.

In convection, heat having been imparted from a surface to one portion of a fluid, that portion thereby expands, becomes lighter than the rest and, in rising, carries away the heat mechanically. A familiar example of this is the air condenser. Some time ago, I carried out some work on one with the object of determining the rate of cooling; and through the kindness of Mr. W. B. Leech, of the Leeds Gas Department, I am able to bring these figures forward. The heat in the gas is given up to the walls of the pipes and transmitted to the outside air. This layer of air expands on heating. Consequently it rises, and is replaced by cooler air from below—forming "Convection Currents." The amount of heat so dissipated does not depend to any great extent on the conducting qualities of the iron, but on the rate at which the layer of hot air is removed. Naturally, a windy day increases this rapidly; so that for the following experiments moderately calm days were chosen.

The condenser tested was one of the vertical type, consisting of eight loops each of four parallel 10 in. pipes, 30 ft. high, connected alternately at the tops by means of bends and at the bottoms by cast-iron seal-boxes, and was one of six similar sets running in parallel. The problem was to measure the gas flow and the heat lost by 1 c.ft. To determine the first, the amount of liquor flowing from the condenser per hour was measured, and was found to be (in one case) 234 lbs. per hour. The quantity condensed per cubic foot was found experimentally by aspirating the gas through a water-cooled spiral. It amounted to 7·64 grams from 0·918 c.ft. between 65·9 and 29·7° C. = 0·0183 lb. per foot. Assuming saturation at the inlet and outlet, the calculated amount condensed would be 0·0179 lb. per foot (neglecting tar); so that this assumption is evidently quite valid. The condenser temperatures were 156° and 77° C., corresponding with a condensation of 0·0225 lb. per cubic foot. Therefore $\frac{234}{0{\cdot}0225} = 10{,}400$ c.ft. was the flow through the condenser. Five out of the battery of six condensers were running at this time, and the gas flow, as measured by the station meters divided by five, was 11,800 c.ft. Therefore the set tested was taking 88 p.ct. of its share. Seeing that it occupied the end position of the row, this would be expected.

The temperature fall from loop to loop was next taken by a duplex copper-constantan thermo-couple. This was used in preference to a mercury thermometer, owing to its absence of lag and the fact that a stem over 6 ft. long was required to reach under each of the four pipes. The figures are shown in Table I. The first line gives the temperature at each seal box in degrees Fahrenheit; the second is the average loop temperature; and the third is the fall of temperature in this loop. The pounds of water carried by 1000 c.ft. of gas (at 60° Fahr. and 30 in. mercury) at each temperature is then given, and, by difference, the weight condensed is shown. The heat evolved is obtained by multiplying this figure by the volume of gas (in thousands) and by the latent heat of steam at the loop temperature. The heat given out by the gas itself equals the volume multiplied by the temperature fall and by the specific heat. In this case, the specific heat of the gas in question was calculated from the analysis, and is taken as 0·023 B.Th.U. per degree Fahrenheit. Nothing is allowed for the tar, as nothing certain was determined as to the relative quantities condensed in each loop; but the heat evolved in its cooling would not seriously alter the totals.

It will be noticed that, although the temperature fall at the hottest loop is only 12·5° Fahr., the heat evolved is almost double that at the fifth loop, where the temperature fall is 17·5° Fahr., and that, except in the two cold loops, the heat from actual gas cooling is relatively insignificant—in fact, it amounts to only 7 p.ct. in the hottest loop. The heat that is given out in B.Th.U. per square foot per hour are plotted against the temperature above atmosphere in Curve I. The diagram also includes another figure obtained on a pipe at 350° Fahr. Provided that the temperature inside and outside are known, it may be assumed that the heat dissipated will be approximately 1 B.Th.U. per hour for each



Curve showing the Relationship between the Quantity of Heat dissipated per Square Foot Area per Hour and the Temperature above the Atmosphere.

square foot of surface and for each degree Fahrenheit above atmosphere, when the temperature is in the region of 150° Fahr., and that this rises to 1·7 B.Th.U. at 350° Fahr. This figure has been used in practice, and been found to be a good approximation. Above these temperatures care should be exercised in using these figures, as other factors begin to have influence—*e.g.*, radiation.

Radiation.

Radiant heat consists of energy waves of a longer wave length than light, and these energy waves can pass through air without heating it to any great extent. The amount of heat radiated is proportional to the fourth power of the absolute temperature—*i.e.*, the temperature in degrees Fahrenheit, *plus* 460, or the temperature in degrees Centigrade, *plus* 273. The zero of the absolute scale of temperature is the lower limit of temperature below which it is supposed to be impossible to go; and the nearest approach to it is, I believe, the melting point of solid hydrogen, at 16° C. absolute, or − 257° C. The heat that is radiated by a surface at an absolute temperature T is therefore KT^4; and if radiating to another surface at temperature T_2 the resultant heat transfer would be $KT^4 - KT^4_2$—*i.e.*, heat is being radiated from a surface irrespective of the temperature of the surroundings; and so the net result is the difference between that radiated by the two surfaces. This factor, K, is $1{\cdot}26 \times 10^{-11}$ for G.C.S. (centimetre-gramme-second) units, and $1{\cdot}59 \times 10^{-8}$ in British Thermal Units per square-foot-hour units. This calculation is only applicable when "perfect radiator" or "black body" conditions prevail; and these conditions may be taken to hold good in any enclosed space above a red heat—say, the inside of a retort or combustion chamber. The reason for this is the fact that a body's radiating and reflecting properties are complementary, and in this way a good reflector is a bad radiator, and *vice versâ*. The best radiator is, then, a body whose surface is dull black. But at temperatures above red heat the differences in the radiating qualities gradually disappear, provided they are in an enclosed space of approximately equal temperature.

As the heat radiated increases with the fourth power of the absolute temperature, it is obvious that at high temperatures very large quantities of heat can be readily transferred by radiation; and this fact can be taken advantage of in the design of furnaces. Thus while an air space is a comparatively good insulator at low temperatures (particularly if evacuated to prevent convection), it

Table I.

Temperature, in °Fahr., at seal-box	57·0	62·5	68·0	80·8	95·5	113	129	145
Average loop temperature	60	65	74	88	104	121	135	
Temperature drop, °Fahr.	5·5	5·5	12·8	14·7	17·5	26·0	12·5	
Water content, pounds per 1000 c.ft. at 60° and 30 in.	0·75	0·90	1·10	1·69	2·74	4·82	8·05	12·5
Water condensed, pounds per 1000 ft.	0·15	0·20	0·59	1·05	2·08	3·23	4·45	
Latent heat, B.Th.U.	2,250	3,000	8,900	15,900	31,500	49,000	67,000	
Heat in gas, B.Th.U.	1,680	1,820	4,000	4,700	5,700	5,200	4,000	
Total B.Th.U.	3,930	4,820	12,900	20,600	37,200	54,200	71,000	
B.Th.U. per square foot per hour	6·2	7·6	20·2	32·4	58·3	85	111	
B.Th.U. per square foot per hour per °Fahr. above atmosphere	0·62	0·50	0·83	0·85	1·08	1·20	1·30	

becomes a comparatively good transmitter at a red heat. It should be noticed, however, that, within reasonable limits, the amount of heat transferred by radiation is independent of the distance it has to travel, and therefore an air space of 1 in. is as good an insulator as one of 10 in. If, then, the air space is divided into a large number of small spaces, the insulating properties are proportionately bettered. This is the reason why finely-divided magnesia makes a good steam-pipe covering, as though, in itself a good conductor (of its class), the fine state of division breaks the air space into minute divisions.

Conduction.

Until quite recently, the measurement of this quality of fire-brick has been rather neglected; but now several independent observers have been evolving methods of working which cover the range of refractories from insulators to conductors. In a paper before the Society of Chemical Industry on March 15, 1915,* were given the results of some work done by the writer under the direction of Prof. Cobb, in which a method was worked out for the determination of the conductivity of full-sized bricks. The aim of this work was to evolve a method applicable to whole bricks, and so to do away with the necessity for specially prepared specimens, and one which did not require very elaborate apparatus, such as large numbers of thermocouples, &c. When this was done, we carried out a number of tests on various bricks.

When temperature conditions are steady, the quantity of heat conducted depends on the difference of temperature between the two faces—the area transmitting heat, the thickness through which it has to be transmitted, and a factor depending on the material. In C.G.S. units the coefficient is the number of calories transmitted by 1 sq.c. in one second across a thickness of 1 cm. when the temperature difference is 1° C., or, in British units, the British thermal units per square foot per hour per foot thickness per 1° Fahr. The former unit multiplied by 242 equals the latter.

In testing a brick for conductivity, the first point was to heat the lower surface equally. At temperatures above 800° C., the brick was heated directly by a large rectangular Meker burner in an enclosed furnace, and the temperature measured optically. But at lower temperatures an iron plate was placed between the brick and the flame to equalize the temperature, which was then measured by a platinum thermocouple tightly wedged in a narrow saw-cut. The sides of the brick were very well insulated by slag wool or Kieselghur, to prevent heat escaping sideways. The temperature of the top surface was taken by a copper or a silver constantan thermocouple, also wedged in a saw-cut. The calorimeter for absorbing the heat was a copper vessel of the same area as the brick, and was firmly cemented to the top surface. A mixture of finely-powdered magnesia, sodium silicate, and fire-clay in varying proportions formed a convenient cement, as it can be made to harden at almost any desired temperature. The heat can be absorbed in the calorimeter either by flowing water, as in a gas calorimeter, or the water may be allowed to boil and the distillate condensed and measured. In either case, although the whole of the brick is covered by the calorimeter, only the heat evolved from a small centre portion is measured, as the outside area is liable to interference by draughts and heat leakages, however well the apparatus is insulated.

As is fairly well known, the heat conducted by a brick between (say) 400° and 500° C. is not necessarily the same as that conducted between higher temperatures. With an ordinary fire-brick the co-efficient of conductivity increases gradually; so that when giving figures it is always necessary to state the range over which they have been measured. The physical condition of the brick has also a very large effect; and it can be readily understood that a "soft fired," or a loosely bonded brick, will have a low conductivity, owing to the particles not being well connected together, and therefore the heat will often have to be radiated from one particle to the next.

Through the kindness of the Farnley Iron Company, I am able to give results on bricks which have been specially "soft fired."

Soft fired Seger cone 8 to 9 . . .	No. 1 brick ..	0·00165 C.G.S. units
		0·40 B.Th.U. sq. ft. hr.
	No. 2 ,, ..	0·0012 C.G.S.
		0·49 B.Th.U.

Temperature range in each case 1000° to 300° C., or 1830° to 570° Fahr.

Hard fired Seger cone 10 to 12	..	0·0036 C.G.S. units.
		0·88 B.Th.U. ,,

Temperature range, 1080° to 330° C.

On testing the soft-fired specimen at the above temperatures again, the results were slightly higher, showing that, on heating to 1000° C., some change takes place in the brick. The difference between the two otherwise similar bricks is large, and may explain to some extent why a new retort-setting takes some time before reaching its best working conditions.

In another experiment, two thin bricks of known conductivity were jointed together with ordinary fire-clay, and then tested. The joint was found to have a conductivity of 0·00012—*i.e.*, 0·029 B.Th.U.—which is roughly one-tenth that of the brick itself. This figure will depend upon how the joint is made and to what temperature it is fired.

I would like to draw attention to an easy method of calculating problems of this nature, by converting conductivities to resistances, which can then be added together.

	Conductivity.	Thickness.	Resistance.	
No. 1 brick .	0·00165	3·82	$\frac{3·83}{0·00165}$ =	2300 units of resistance.
No. 2 brick .	0·00217	3·82	$\frac{3·82}{0·00217}$ =	1750 ,, ,,
				4050 ,, ,,
Combined specimen	0·00136	7·8	$\frac{7·8}{0·00136}$ =	5700 ,, ,,
Deduct the resistance of the bricks				4050
Leaving the resistance of the joint				1650

The thickness of the joint = 0·2. Therefore the conductivity of the joint = $\frac{0·2}{1650}$ = 0·00012.

The importance of avoiding cross joints wherever possible is emphasized by the above figures, particularly in regenerators, where the maximum heat travel is desired and the temperature difference is not so very great. In the above case, an equivalent thickness of fire-brick without joint and the same average conductivity would transmit 40 p.ct. more heat than the one with a joint under similar temperature conditions.

The increase of the co-efficient with rising temperatures is shown by both fire-clay and silica [see Table II.]; but magnesia, on the other hand, we found to decrease. The samples of magnesia brick used were the fine-grained "Mabor" bricks; and, owing to the rather unexpected nature of the results, experiments were carried out over a very wide range. In this connection, it is interesting to note that the electrical conductivity of metals usually decreases with rise of temperature.

Another factor influencing the conductivity is the porosity. As previously shown, a highly porous material will be a worse conductor than the same material when in a compact, well agglomerated state. But the variations in the state of porosity, as the size and number of pores irrespective of their total volume, are so great that it is difficult to co-relate the two qualities more exactly. In Table II. are summarized the more general results on various bricks, and are given in B.Th.U. as well as C.G.S. units.

Table II.

Specimen.	Specific Gravity.	Apparent Porosity P.Ct.	Temperature ° Fahr.	Range ° C.	Conductivity. C.G.S.	Conductivity. B.Th.U.
Fire-brick . .	1·95	23·3	1470 to 570	800 to 300	0·0029	0·71
			2010 ,, 570	1100 ,, 300	0·0036	0·88
			2640 ,, 1020	1450 ,, 550	0·0040	0·98
Similar brick .			2010 ,, 750	1100 ,, 400	0·0033	0·81
			2460 ,, 930	1350 ,, 500	0·0039	0·96
Similar brick but "soft fired" .	1·90	28·7	1830 ,, 570	1000 ,, 300	0·0017	0·42
			1920 ,, 320	1050 ,, 300	0·0020	0·49
Siliceous brick 82 p.ct. silica .	1·82	28·2	2370 ,, 570	1300 ,, 300	0·0025	0·65
Silica brick 95 p.ct. silica .	1·75	24·7	2280 ,, 840	1250 ,, 450	0·0039	0·96
			1830 ,, 570	1000 ,, 300	0·0030	0·74
Similar brick .			2190 ,, 750	1200 ,, 400	0·0035	0·86
			2550 ,, 840	1400 ,, 450	0·0042	1·03
Magnesia brick 92 p.ct. MgO .	2·40	31·4	716 ,, 518	380 ,, 270	0·0170	4·15
			1040 ,, 608	560 ,, 320	0·0151	3·70
			1112 ,, 752	600 ,, 400	0·0148	3·62
			1292 ,, 842	700 ,, 450	0·0132	3·22
			1382 ,, 878	750 ,, 470	0·0116	2·83
			1607 ,, 977	875 ,, 525	0·0110	2·68
			1877 ,, 1076	1025 ,, 580	0·0101	2·46
			1904 ,, 1094	1040 ,, 590	0·0098	2·40
			2498 ,, 1292	1370 ,, 700	0·0091	2·22

DISCUSSION.

The President said Mr. Dougill had got a wonderful grasp of his subject. Primarily, the question of the transmission of heat through the refractory walls of a retort was, in all systems of carbonizing, most vital in vertical retorts. The idea of the downward flow of coal absorbing heat and being carbonized must be looked upon as something in the manner of an inverted circular cone, if he might put it so. It must be a matter primarily of conduction of heat through the outside walls of the retort. In regard to Mr. Dougill's view that there would be a thickness of at least 3 in. of the material providing the retort wall, it occurred to him that, in the case of vertical retorts, a thinner wall retort might be tried experimentally to see whether any better effect in the way of increased conductivity could be obtained by trying to get the heat through a thinner wall of resistance. In regard to retorts, he was always struck, in relation to single horizontals, with the enormous amount of material which was placed in the horizontal oven, all of which must take away from the available heat units in the furnace. What a tremendous amount of superfluous material was put into the retorts to begin with! Had Mr. Dougill any idea of this being cut down with the object of saving fuel?

Mr. A. Edwards said that it was while Mr. Dougill had been working with the concern with which he was connected that he had obtained

* See "Journal," Vol. CXXX., p. 454-7.

some of his highly interesting results in regard to the transmission of heat on conduction; and it was while he was considering the tar-washing schemes of the Government, in which they had to cool the tar to a fairly low temperature, that they were up-against the problem of finding definite areas necessary for cooling. It was to obtain some particular factor for the heat dispersion that the experiments were instituted in this particular set of condensers. The result of Mr. Dougill's ingenuity and perseverance was that they did find a very reliable figure of British thermal units per square foot; and in applying this to the condensers in which they were cooling tar, they found that, taking this factor into account, the area they had allowed was amply sufficient. With reference to Mr. Dougill's other experiments of conduction at high temperatures, he had said that it was no use relying upon conduction figures at low temperatures. His actual figures had been calculated from temperature differences of the order of 1000° to 300° C. Between the inside and the outside surfaces of the retort there was a variation of something of the order of 300° to 200° C.; so that there was a temperature drop of 1000° to 800°. Could Mr. Dougill, by calculation, obtain the real radiation co-efficient of conductivity for these high temperatures? From his results, from 300° or 400° down to ordinary temperatures, it should be possible to calculate true radiation co-efficients; and he wondered whether Mr. Dougill had done so.

Mr. H. H. Collett said Mr. Dougill had brought out to them very clearly the importance of conductivity in connection with retort settings. The author had said that to oppose a fire-clay joint across the direction of heat was to very largely reduce the conductivity. There were cases, for instance, where they could not avoid placing the shields round retorts; so that this loss would have to be borne with. In the case of some regenerators that he had in his mind, there were two flat tiles back to back with a joint between them. The whole surface of the regenerator between these two tiles was one huge fire-clay joint; so that in this particular form of regenerator in connection with vertical retorts there was a very large surface of fire-clay joint. Another regenerator in which the same thing occurred was Gibbons's "A.B.C." regenerator. It appeared that a great deal of loss of heat occurred owing to the large fire-clay joint. It was evident that there ought to be an effort to design a regenerator to overcome this. With regard to porosity in fire-clay materials, he had always understood that the best fire-clay materials were those which combined the highest porosity with the greatest mechanical strength. Mr. Dougill's point with reference to the transmission through "air spaces" at high temperatures was interesting and well worth bearing in mind. In many cases they saw that these air spaces were placed where the temperature was fairly high, and evidently they should, to make the most use of them as insulators, be filled with material like kieselghur, which would give a very large number of air spaces instead of one large air space.

Mr. Dougill, in replying, said that with regard to Mr. Garsed's proposition that it might be advantageous to thin the walls, it was necessary to take everything into consideration. Probably if they were to thin the walls they would be obtaining more heat through them, and thereby getting the possibility of a bigger throughput of coal; and a larger output would bring down their costs and increase the cost efficiency of the whole setting. Whether or not from a mechanical point of view the walls could be thinned, however, he did not know. In a horizontal retort, there was a great amount of weight; and it was subject to considerable mechanical stresses. He doubted, therefore, whether it could be done in that case. Even in the case of the vertical retort, the weight on the retort must be considerable. He doubted whether the benefit which they would get from thinning the walls would counterbalance the disadvantages. Under some conditions it might do so perhaps. The idea had often been put forward that the amount of heat was not dependent upon conduction, but that the fire-brick walls could heat up to a high temperature and act as a reservoir of heat, and that in some way they could escape the necessity of putting the heat through the walls. This did take place. But the heat was still conducted through the walls; and the conductivity factor was the decisive one on the quantity conducted. This "reservoir action" was part of the benefit of the tremendous mass of brickwork in the retort. If they had not this reservoir of heat, their retorts would be cooled down more than they were when charged. He thought the large body of fire-clay in the retort-setting was very desirable. In regard to shields, he considered they were put in simply as resistance in many cases. They needed a very high temperature in their combustion chamber; and if they allowed the inside of the retorts to be exposed to this high temperature, they were simply asking for trouble. So they put in a resistance in the shape of a shield. The temperature on the outside of the retorts was cooler; and so they were equalizing the temperature inside by putting the shield on against the highest temperature and getting the equivalent of a thinner retort wall on the outside. In regard to the point raised by Mr. Edwards, as to true conductivities, the normal conductivities were actual conductivities over a certain range; and the figures he had given were conductivities over the ranges specified. It was possible to calculate the true conductivities throughout; but it was a complicated job. He had equations which would give the true conductivity at any temperature. In regard to regenerators, the regenerator mentioned by Mr. Collett was a very good one. There was a cross joint certainly; but it illustrated the point that one could not always carry out theoretical ideas. They were trying to get the maximum amount of heat through the wall, which consisted of fairly thin slabs of refractory material. The total thickness of the material through which the heat had to be conducted was considerably less than that in the majority of regenerators; and though a cross joint was detrimental from a "heat" point of view, if it could be dispensed with they did not really lose anything by it, because, by having the joint in, they strengthened the regenerator mechanically against air bye-passing, and so could use a thinner wall. Many regenerators had from 3 in. to 4½ in. brick walls; whereas in the case Mr. Collett mentioned the walls would be only 2½ in. In regard to porosity, this was a difficult point. For retorts one usually aimed at getting the highest possible porosity consistent with strength. In most retorts they usually found rather coarse grained material with fairly large pores. There might be something such as 30 to 40 pores to the inch, or there might be from 600 up to 1000 per inch; and the variations brought them to such a mass of varied possibilities that they could hardly get them into line. There must be high porosity for some things, and then they had to put up with a lower conductivity. Balancing it all round, they could only take the average of all the good points. When they had figures of different qualities of materials, they could see which was the best compromise.

A cordial vote of thanks was awarded to Mr. Dougill.

DIRTY COAL DIFFICULTIES.

A Boston manufacturer, Mr. E. G. Bailey, in the course of a lecture delivered at the Johns Hopkins University, claimed that the abnormally high percentage of ash and impurity in coal as at present supplied was the biggest and most important problem before the public to-day. It slowed-down rail and water transportation, and practically all industries directly or indirectly dependent on the use of coal, at a most critical time. The price had been regulated without regard to quality, just when there was an imperative need of heat units in the highest concentrated form obtainable. To say that the railway companies to-day were burdened with the transit of millions of tons of rubbish, and that the user was compelled to pay full price for a diluted article, did not cover the situation. There was also the consequent decreased output, lowered capacity of plant, increased labour, and heavy additions to repair and maintenance costs.

A moderate estimate of the increased tonnage due to the poorer quality was 5 p.ct. On the basis of 600 million tons raised in 1917, there was the extra expense of handling 30 million tons of useless slate and dirt, the transport to the user's premises, the actual dealing with the coal, and the disposal of waste to be considered. The loss to consumers, who eventually had to pay the whole of these extra expenses, was not less than £24,000,000 per annum; and in view of restricted consumption, heatless holidays, &c., an immediate remedy was of enormous National importance. Many consumers would be glad to pay more for standard quality, and would increase production and save money by so doing.

Under normal conditions, the quality of coal supplied was controlled by competition; and the removal of this influence by excessive demand, together with the fact that in fixing prices the Government had drawn no distinction between the good and bad coal, were responsible for the present situation. Why should one colliery go to the expense of properly cleaning the coal, when it has to sell on equal terms with competitors who will not do so? Appeals on patriotic grounds, or acceptance of increased prices, would be of little use. A successful remedy must have economic foundation. The existing all-round rates should be replaced by standards established by the local fuel administration to suit the district under their control and premiums based on the ash content, with special consideration for the slate and rock that could and should be eliminated at the mines. Suitable testing-stations might be established at the principal centres of consumption, so that samples could be taken and examined without knowledge on the part of the consignors. The producer having done his part, it was for the consumer to see that the fuel was used with every practicable economy and avoidance of waste. Between the two, present transport congestion could be greatly relieved without reduction of productive capacity.

In concluding, the lecturer referred to indications that, in the absence of immediate and adequate remedy, a serious position would be encountered in the ensuing winter.

LIGHTING CURTAILMENT AND FUEL CONSERVATION.

At a meeting in New York of the American Illuminating Engineering Society, held for the purpose of considering the extent to which the lighting industry could co-operate in the conservation of fuel, a paper on "Lighting Curtailment" was submitted by Mr. P. S. Millar, the General Manager of the New York Electrical Testing Laboratories.

The author pointed out that the coal consumed in producing electric light was only 2 p.ct. of the total consumption in the country. Curtailment of this 2 p.ct. used for lighting, as compared to the curtailment of 98 p.ct. of fuel used for heating, locomotion, and other purposes, appeared, therefore, to be relatively negligible. He recommended a re-adjustment of present lighting intensities—emphasizing the importance of increased intensities and proper use of light for war-time protective purposes, and urging a conservative decrease in intensities in some special civilian lighting services. The balance of desirable re-adjustments, however, resulted in a net decrease of only 3 p.ct. This curtailment of 3 p.ct. would result in a saving of about 340,000 tons of coal per year—little more than five one-hundredths of 1 p.ct. of the total. The disadvantages which would probably result from a radical decrease of intensity in residential and business districts, involving danger to life and property, were pointed out. It was remarked by Mr. Millar that it is practicable to effect much larger savings by other methods, with less disadvantage to the public.

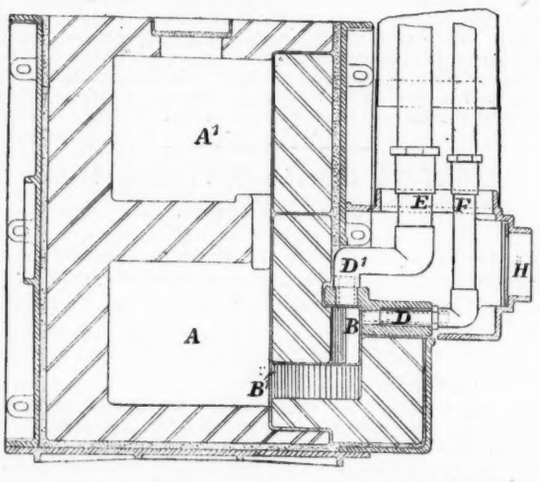
The conclusions he arrived at were that members should promote the elimination of waste in lighting and the use of more light in the industries. Because little coal can be saved in lighting,

it would appear to be incumbent upon them to be even more diligent in the elimination of extravagance and waste in order to accomplish their part and to make possible the use of more light where it is needed for the purpose of promoting industry. Any general curtailment of lighting would be a menace. For the last eleven years, the Illuminating Engineering Society have devoted a large part of their efforts to promoting good illumination. The research and investigation of members on the effect of light upon the eye, the influence of technical discussions upon the design and installation of lighting appliances, and popular educational campaigns in the fundamentals of good lighting have resulted in improvement of lighting practice, especially in the more recent installations. A small beginning has been made toward approximating daylight characteristics in artificial lighting. The important feature of daylight which it sought to emulate is diffusion of light. Without this quality, daylight intensity would be unbearable. In order that artificial light may be diffused, an ample supply must be produced. If the quantity of light were reduced, means for diffusing it would be discarded, and it would be used in its raw or crude state. This would set back by ten years or so the development of the lighting art which has been in the interest of the public. It would do more—for in the interval much more brilliant light sources have been substituted for those of ten years ago. To remove light-diffusing safeguards would leave these brilliant illuminants exposed.

GAS-BURNERS FOR METALLURGICAL FURNACES.

An improved gas-burner for furnace work has, says the "Iron and Coal Trades Review," been introduced by Mr. H. James Yates, of Birmingham, and Mr. S. N. Brayshaw, of Hulme, Manchester. The object aimed at is to provide a burner to work with gas at the normal main pressure and air with only a few inches head of water, though it may be used with gas under pressure.

The furnace (as illustrated) is of ordinary construction, with two chambers A A^1 for heating steel articles for hardening or tempering purposes. In the furnace wall a combustion chamber, BB^1, approximately L-shaped, is formed, with the upper branch B vertical and parallel with the wall, and the lower branch B^1 horizontal and parallel with the furnace floor—the horizontal branch being provided with inclined sides to spread the flame as it enters the furnace. The burner is constructed with two nozzles DD^1 for the gas and air respectively. The gas nozzle enters the vertical branch of the combustion chamber at, approximately, right angles; the gas jet being projected across it. The air nozzle enters the same branch of the chamber at one end; the air jet being projected longitudinally towards the horizontal branch and so across the end of the gas nozzle—thereby securing a thorough mixture of the gas and air, which, on ignition, burns within the horizontal branch of the combustion chamber and issues from it in a broad flame into the furnace.



Cross Section of the Furnace, Showing the Arrangement of the Burners.

Instead of supplying the full quantity of air to support combustion from the air nozzle D^1, and to ensure a better mixture of the gas and air, a portion of the air from the air-supply pipe E (but not enough to support combustion or create an explosive mixture) may be injected into the gas-supply pipe F at some distance from the gas nozzle by an injector fitted into the pipe.

Modifications are provided for—more particularly in regard to the disposition of the gas and air pipes E F, which may be placed at right-angles to the vertical branch of the combustion chamber, or for preheating the gas and air may be carried up vertical and across the top of the furnace, which is thus brought into contact with the products of combustion which pass away through the flue H. The combustion chamber may also be arranged with the horizontal branch above instead of (as shown) below the vertical one.

DETERMINING DISCHARGE OF GAS THROUGH HIGH-PRESSURE MAINS.

A Simple Formula.

Dealing with the flow of natural gas, sp. gr. ·6, through pipes of various diameters and length, Mr. E. O. Hickstein, in the "American Gas Engineering Journal," compares several rules in regular use, and recommends the following as having proved reliable in his experience, which includes hundreds of examples from everyday working.

$$Q = K_2 \frac{\sqrt{P_1^2 - P_2^2}}{\sqrt{L}}$$

Q = gas discharged in c.ft. per hour.

K_2 = a constant peculiar to the diameter of the pipe. From 2 in. up to 18 in., it may be taken as follows:

2 in.	6·38	8 in. . . .	232·0
3 in.	17·62	10 in. . . .	424·0
4 in.	36·75	12 in. . . .	703·5
5 in.	66·10	16 in. . . .	1338·0
6 in.	110·40	18 in. . . .	2147·0

12 in. outside diameter 534·1

P_1 = pressure in lbs. absolute at inlet of line.

P_2 = pressure in lbs. absolute at outlet of line.

L = length of line in miles.

$K_2 = \frac{K_1}{\sqrt{GT}}$ and the figures above given are calculated on the basis T = absolute temperature = 520° Fahr. G = sp. gr. of gas = 0·6 to 0·7 in practice.

Gas for Making Synthetic Gems.

In his New York laboratories, Dr. Maurice N. Aisen, by the aid of the most exact science and the assistance of gas, is at the present moment manufacturing synthetic jewels that are said by Mr. R. E. Livingston, writing in the "American Gas Engineering Journal," to rival in lustrous beauty those made in Nature's long-process laboratories. He has formulæ which produce almost all known jewels and semi-precious stones; the notable exception so far being diamonds. After a gem has been analyzed and its component minerals found, the same proportions of ingredients are assembled and put into crucibles, where they are raised to any temperature that may be desired, and then suddenly cooled. Certain jewels need a tremendous heat; and in order to meet this requirement, Dr. Aisen has had one appliance specially designed for him by the Industrial Department of the Consolidated Gas Company of New York, which raises the ingredients to a temperature of approximately 3100° Fahr. While work is still being done on improving the construction of this appliance, the present arrangement procures the needed temperature and accomplishes the jewel making. It is by a scientific combination of town gas and oxygen that the necessary high temperature is developed and sustained. At the top of the appliance is a mechanically agitated hopper, with the gas-flame below, and under this a platform or pedestal. With every movement, after the ingredients are placed in the hopper and it is set in action, a tiny flake or crystal comes down, passes through the high-temperature zone, and remains at boiling-point until the mass is large enough for a gem. The burners used are water-jacketed, with detachable tips. There are other gas-operated machines in the laboratory; and Dr. Aisen finds them a great advantage in his work.

Comparative Efficiencies in Gas.

Reporting in the "American Gas Institute News" on a test conducted to determine the relative efficiency of two gases of different calorific values in the cooking of standardized meals, Mr. C. O. Bond says that one of the gases was a mixture of carburetted water gas and coal gas having an average heating value of 660 B.Th.U., and the other (produced by using a carburetted water gas diluted with blue gas) an average value of 592 B.Th.U. The test took place in a restaurant; the cooking appliances being adjusted for use with the 660 B.Th.U. gas (Gas A), and the adjustment not being changed when the 592 B.Th.U. gas (Gas B) was turned on. The procedure was to allow the restaurant to use Gas A for several days, noting the consumption and heating value during these days, and then, without giving notice to the employees of the restaurant, to make the change to Gas B for several days, when similar readings would be made. This was continued for a number of weeks. The menus being similar on the same days of the week, it was possible to make quite correct comparisions between the amounts of food cooked and the gas used. One table shows the result of using Gas A on ten days to have been a consumption of 6520 c.ft., or an average of 652 c.ft. per day. Eight days' use of Gas B (the different days of the week not being proportionate to those in the first test) gave a consumption of 5000 c.ft., or 625 c.ft. per day. This shows that the consumption of the low calorific power gas was about 4 p.ct. less than that of the higher B.Th.U. gas. The final table indicates the consumption on different days of the week with each gas. This shows that on Tuesday the consumption of Gas B was 9·6 p.ct. less than that of Gas A, on Wednesday and Thursday it was 6 p.ct. greater, and on Friday it was 15 p.ct. less.

CORRESPONDENCE.

[*We are not responsible for opinions expressed by Correspondents.*]

Gas and Gas Rationing.

Sir,—With the exception of the fifth paragraph of Mr. Moon's excellent letter, I am heartily in agreement with him.

His five suggestions, as a basis of policy, form substantial ground for an amendment of the present system, which will, I fear, be found costly in labour, difficult to understand and carry out by the individual consumer, and the net result disappointing.

By no means penalize any district in which the gas-works have available manufacturing plant. On the contrary, make the works a centre of gravity for the production of residuals essential to the country.

This war has reversed the order of things. I feel that, onwards, the primary product from coal will be the residuals of to-day, and gas will be secondary. Thus it is in the national interest that the wasteful use of coal shall be restricted wherever possible to the utmost, and gaseous fuel provided in its place.

April 17, 1918. Southern County Undertaking.

Production of Benzol and Toluol.

Sir,—I shall be glad if you would be good enough to publish the enclosed two letters, which are self-explanatory.

E. W. Smith, Chief Chemist.

Central Laboratory, Gas-Works, Nechells, Birmingham, April 19, 1918.

[Enclosures.]

Ministry of Munitions of War,
Explosives Department,
Storey's Gate, Westminster, S.W.1.,
April 17, 1918.

Dear Sir,—In the current number of the "Gas World" you are reported to have said, at the annual general meeting of the Midland Association of Gas Engineers, that "there was not much inducement to produce increased quantities of benzol and toluol, for stocks were ample, from what he could gather."

Whereas that statement is liable to create a false impression, and to affect adversely the aims and interests of this Department, I am to ask you to be good enough to take the first opportunity of making the necessary correction. The need for the maximum recovery of toluol and benzol is as great as it has ever been in the past.

(Signed) F. L. Halford.

E. W. Smith, Esq., Chief Chemist,
Corporation Gas-Works, Birmingham.

To F. L. Halford, Esq.,

April 19, 1918.

Dear Mr. Halford,—I have to thank you for your letter of the 17th inst., and hope that no surmise of mine relating to the stocks of benzol and toluol will have adversely affected the aims and interests of your Department.

I now note that the need for the maximum recovery of toluol and benzol is as great as it has ever been in the past; and I am sure that my erroneous deductions on this question will have served an excellent purpose if it is only to have drawn from the authorities an explicit statement as to the requirements for these products.

I am sure your statement will be the means of giving a still further impetus to the enthusiastic support which the bulk of the gas industry has given your Department in their endeavours to still further increase the supplies of benzol and toluol.

I have sent a copy of this letter, and also a copy of your letter to me, to the "Gas Journal" and the "Gas World" for publication.

E. W. Smith.

Tar Accumulations and Dehydration Plants.

Sir,—I note in the report of the meeting of the Midland Association of Gas Engineers and Managers the receipt by the Hon. Secretary of a letter from the Secretary of the National Gas Council in regard to tar dehydration plants. It occurred to me that perhaps the expression of individual opinions might not be out of place, and might lead to a useful discussion or other movement with regard to the question; and with this object in view, I submit the following.

First, I note that in the reply of the Ministry of Munitions it is pointed out that no compensation could be granted to gas companies for the non-use of plant erected at their own (the companies') risk, which to my mind is perfectly fair and just, if, when the installation took place, the companies were not guaranteed by the Ministry of Munitions or other Government Department. After all, the provision of so-called dehydrated tar, with a view to its use for road purposes, is no doubt undertaken by companies concerned as a possible source of revenue; and if the exigencies of the moment restrict its sale, how can they grumble any more than a man who (say) grows potatoes for profit and finds afterwards that the demand for them has fallen off, or their sale restricted for some reason best known to the Government?

It is certainly a matter for regret that large stocks of undistilled tar are allowed to accumulate; and I think the Ministry of Munitions should be approched, not so much from the road use point of view, as from that of the necessity of providing munitions of war. I should be very much surprised if, in the near future, the Ministry of Munitions will not be appealing to the companies to re-start their plants, in view of the known losses and expenditure of material consequent on the latest enemy operations; so that probably before the Council have time to approach the Ministry the position will have automatically adjusted itself.

The term dehydration is, to my mind, very ambiguous, and does not properly convey the meaning or extent of the operation. One must remember that in these plants the heavier and less volatile constituents are not distilled off; and some of these are of the utmost importance just now. The tar when simply prepared for road work still contains a large quantity of very valuable material; and possibly this is one of the reasons why the Ministry of Munitions will not allow its use for road purposes. I think that all tar should be distilled to pitch, and the stock of the latter allowed to take care of itself for the present, or—in view of the possible discovery of a suitable means of disposal of the tar for fuel purposes, and, coincidently, the winning by some fortunate investigator of the Government prize—that it is wise to conserve our stocks of tar.

I do think, however, that some effort might be made to induce the Ministry of Munitions to facilitate the removal of excess stocks of tar to proper distilling plants, although I have little doubt that they are doing their best in this direction.

In short, with regard to

1.—The question of compensation, I do not think the companies have much of a case.
2.—The point made by the Ministry of Munitions *re* oil-washing is a good one; and the companies might do worse than employ their plants in this or some similar manner *pro tem.*
3.—Distillation and dehydration are totally different operations, and it is, in my opinion, better, in the existing circumstances, to have a large stock of tar in its best form, than to only partially distil it and throw the remaining valuable constituents on the road.

Alpha.

April 17, 1918.

[The question of tar accumulations and the provision of dehydrating plants has to be considered in relation to the circumstances of the time and of locality. In the first place, quite a number of gas undertakings adopted tar-dehydrating plants not specially with the view to the provision of dehydrated tar for road purposes, but as an auxiliary to the "C" process, with the view of promptly assisting the Government in the provision of the benzol and toluol which were so urgently required in the early months of the war. We admit the inefficiency of the plants even for this purpose, as compared with full range tar-distillation plants. Those who adopted dehydrating plants specially for the purpose of quickly meeting war needs, have therefore some claim upon the consideration of the Ministry of Munitions, unless location puts them in the position of being able to make profitable use of the plants later on for road purposes. Many works cannot afford to run a tar-distillation plant of their own (the arguments for co-operative local distilleries come in here), and, despite the fact that the dehydrated tar contains a large quantity of valuable material, it may be that transit to a distillery at a distance, and the return to the district of the requirement for road purposes, would not in peace times justify the expense of transit. Reading it in the light of current circumstances, with the main part of "Alpha's" letter, we quite agree. The country cannot afford to-day to lose the valuable material in what is called dehydrated tar. Our editorial columns bear witness to this.—Ed. G. J.]

Drying Sewage Sludge.

Sir,—De-watering and drying sewage sludge will create a nuisance, as it does in this town. They make different sorts of manure. In Lyons, they extract ammonia, &c.; and on the Seine (Paris) there are works. In Dresden, they make briquettes which are put into retorts for gas making, as was mentioned in the "Journal." In Holland, there are also works, as well as in a good many other places on the Continent.

Why evaporate and throw off into the atmosphere all these chemicals? Tar was, and I believe still is, kept in large open tanks—to evaporate. Naphthalene is also kept to dry and evaporate products which have more value than the crude article itself. Why should gas companies waste heat? The blast-furnaces in France use it.

Let us find out how to make good use of every product, and call in the chemist.

C. Dasnières.

Toulon, April 15, 1918.

Rate Relief and Gas Price at Newton-in-Makerfield.—A letter has been received by the Newton-in-Makerfield Urban District Council from the Local Government Board, enclosing the draft of a Provisional Order which they propose to issue for altering the Newton District Improvement Act, 1855, and certain Confirming Acts, so as to enable the Council to apply profits of the gas undertaking in aid of the general improvement rate when the price of gas to private consumers (other than through prepayment meters) does not exceed 3s. 6d. per 1000 c.ft., instead of 3s. as at present. The Board stated that they did not consider the circumstances required a higher increase to be authorized.

Household Fuel Rationing.—A conference of Midland local authorities, summoned at the request of the Coal Controller to discuss the rationing scheme which will shortly come into operation, was held in Birmingham last Thursday. The Lord Mayor said it was intended to apply the scheme to all forms of fuel, and that account would also be taken of the amount of gas and electricity consumed. The scale was based on the house accommodation. Local authorities would be grouped for the purposes of the scheme. Mr. Frank Pick (who represented the Coal Controller) stated that it had been decided to apply the scheme to the whole country. A reduction in the use of coal would be secured mainly at the expense of the householder. In order to avoid the rationing of supplies for industrial purposes, it was hoped to effect an economy in household coal equal to the reduction in the output at the pits, which would vary from 25 to 33 p.ct.

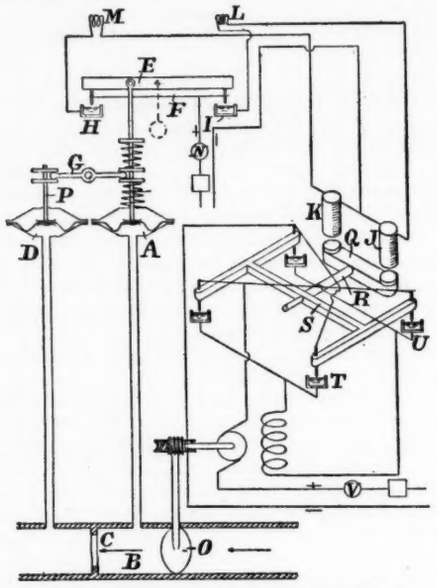
REGISTER OF PATENTS.

Regulating the Pressure or Flow of Gases. No. 112,502.

Pratt, A. W., of Westcliff-on-Sea, and Staniforth, H., of Farringdon Road, London.

No. 483; Jan. 10, 1917.

The purpose of this invention is to provide a means whereby the rate of a gas or fluid flowing through a pipe may be kept constant while the pressure may vary, by employing two closed pressure chambers in communication with the main behind the valve (one on either side of a throat or restricted opening); the diaphragms of the pressure chambers being connected to a lever adapted to cause the mechanism to be set in motion to regulate the valve in the main conduit. Adjustable springs or weights regulate the effect of the pressures—"the whole being arranged so as to secure a constant difference of pressure on the two sides of the throat."



Pratt and Staniforth's Pressure Regulator.

A closed pressure chamber A is arranged in communication with the main B, on one side of a throat or restricted opening C, and a second pressure chamber D is arranged in communication with the main on the other side of the throat. A rod attached to the diaphragm of the chamber A rises and falls with it; at the same time rocking the beam E about its centre. At each end of the beam are metal pins electrically connected with the wire F or other equivalent. The beam and the rod with the attached diaphragm are kept in the normal or out-of-action position by springs shown, having suitable means for adjusting their strength. The pressure chamber D is connected by a lever G rocking about a centre, so that the pressures in the two pressure chambers counteract each other.

Cups H I, containing mercury, have attached wires capable of conducting a current to the electro-magnets J K respectively; while resistances L M are inserted to reduce the current flowing to the electro-magnets. N is the source of electricity; and the current flows in the manner described later on.

The action of the apparatus is as follows: Assuming the gas to be flowing in the main B from right to left—that is, from the valve O towards the throat C, if the pressure rises in the main on that side of the throat in which is situated the pressure chamber D, the diaphragm will rise, carrying with it the rod P, and, by means of the beam G moving about its centre, will depress the rod above the pressure chamber A. This action will draw down the metal point into its cup of mercury H, completing the electric circuit. Current then flows from the source N through the resistance M to the electro-magnet K, which is thus energized. The magnet then attracts the end of the beam Q, and partially rotates the shaft R, which, in turn, causes the beam S to dip the pins into the mercury cups T U and so completing a second circuit. Current then flows from the source V and causes the armature to open the valve. When conditions have returned to the normal, the diaphragm in the pressure chamber D moves under the action of the controlling spring and moves the beam E to its out-of-action position, lifting the pin from the mercury H, breaking the electric circuit, and de-energizing the magnet K. The end of the rocking beam Q then ceases to be attracted by the magnet and falls away; and in doing so, it partly rotates the shaft R and beam S, with both of which it is integral, and lifts the pins out of the mercury cups T U, so breaking the second electric circuit.

A rise of pressure in the Chamber D has the same effect as a fall of pressure in the chamber A, and the motor will therefore open the valve until the rise of pressure in A restores the correct differences, and the apparatus will then cease acting. Thus the pressures on the two sides of the throat C will be maintained at the desired constant difference, and the flow of the fluid be maintained at a steady rate.

Gaseous Fuel Furnaces.—No. 114,223.

Ionides, A. C., jun., of Porchester Terrace, W.

No. 5352; April 16, 1917.

This invention relates to furnaces in which a nozzle for supplying a gaseous combustible is led into one or more passages or ducts formed in the interior surface of the heating chamber and opening to the chamber along the whole (or greater part) of the length of the ducts.

In patent No. 108,701 the inventor described furnaces for the utilization of combustible gaseous mixtures, wherein the combustible and the supporter of combustion are admixed in self-burning proportions, "permitting practically complete combustion without unnecessary residue of either constituent." The object of the present invention is to simplify the construction of such tubular furnaces so that the distribution is improved and flames will not directly impinge upon the object to be heated.

The invention consists in a furnace in which a series of upright combustion chambers or passages are arranged in or upon the encircling wall of an upright tubular heating chamber—the passages communicating with the heating chamber by one or more narrow openings, slits, or orifices, and being supplied with combustible gaseous mixture by jets or nozzles positioned at or near their lower extremities. The passages are spaced equidistantly around a cylindrical heating chamber, being formed in the thickness of the wall at the longitudinal joints of the bricks, and communicating with the chamber by slits or orifices preferably having a side tangential to the surface of the chamber wall.

Production and Separation of Ammonium Sulphate and Glauber's Salt.—No. 114,236.

Dawson, H. M., of Headingley, Leeds.

No. 6767; May 12, 1917.

This invention relates to the manufacture of ammonium sulphate and sodium sulphate by the absorption of ammonia in a solution of nitre cake, sodium bisulphate, or other acid sodium sulphate—such solution being prepared by dissolving these substances in water or in a mixture of water and sulphuric acid.

The patentee points out that the use of nitre cake, instead of vitriol, for the absorption of ammonia has been previously suggested, and a method for the separation of sodium sulphate and ammonium sulphate from solutions of the mixed sulphates has been proposed, which involves four distinct stages or operations: (1) Crystallization of Glauber's salt by cooling; (2) production of mixed sulphates by evaporation of the mother liquor; (3) treatment of the mixed sulphates with water or other liquors to produce solutions rich in ammonium sulphate; (4) evaporation of the resulting liquor to give crystals of ammonium sulphate.

The process which he describes for the separation of the two sulphates involves only two stages—Glauber's salt being obtained by refrigeration and ammonium sulphate by the subsequent evaporation of the resulting mother liquor at or about 100° C.

When solutions of suitable concentration are cooled, Glauber's salt crystallizes out; and, in consequence, the ratio of ammonium sulphate to sodium sulphate in the mother liquor increases. The resulting liquor, if evaporated, deposits free ammonium sulphate until the ratio has fallen to a lower value. The product of crystallization at low temperatures consists entirely of Glauber's salt so long as the molecular ratio of ammonium sulphate to sodium sulphate does not exceed a certain value, which increases rapidly with a fall of temperature from 1 at about 20° C. to about 12 when the cryohydric temperature (−20° C.) is reached. Solutions containing a relatively large proportion of ammonium sulphate, when evaporated in the neighbourhood of 100° C.—for example, by steam heating—deposit pure ammonium sulphate so long as the molecular ratio of ammonium sulphate to sodium sulphate in the mother liquor does not fall below about 2·7. These relations afford the basis for the procedure which is followed in the actual separation of ammonium sulphate and Glauber's salt from solutions which contain the two sulphates.

The solution (Solution A) employed for the absorption of ammonia is prepared by dissolving nitre cake, sodium bisulphate, or other acid sodium sulphate (with or without the addition of sulphuric acid), in a suitable quantity of water. When the free acid in the solution has been more or less completely neutralized by ammonia absorption in a saturator, the concentration of the liquor is adjusted, if necessary, so that the ratio of water molecules to salt molecules (sodium sulphate *plus* ammonium sulphate) is approximately given by 1000: 70 to 80.

The adjusted liquor (Solution B) is then transferred to a refrigerating tank, in which it is slowly cooled, when Glauber's salt crystallizes out and the ratio of ammonium sulphate to sodium sulphate in the mother liquor is thereby increased. The degree of cooling is limited by the cryohydric temperature (about −20° C.) and further by the fact that ice may be deposited at temperatures considerably higher than this, if the adjusted liquor from the saturator contains a relatively small proportion of ammonium sulphate. In general, it will be found convenient to cool to −10° or −15° C. The separated Glauber's salt may be removed from time to time during the cooling process.

If the molecular ratio of sodium sulphate to sulphuric acid in Solution A is relatively high (as will be the case if this solution is prepared from nitre cake without the addition of sulphuric acid), it is advantageous to employ a more concentrated solution for the absorption of the ammonia; and in these circumstances, a portion of the sodium sulphate will be deposited in the anhydrous form in the saturator. This does not in any way modify the subsequent treatment of the solution in the saturator.

The mother liquor (Solution C) from the refrigerating tank is now transferred to an evaporator, and on evaporation at or about 100° C., ammonium sulphate crystallizes out until the molecular ratio of ammonium sulphate to sodium sulphate has fallen to about 2·7. If pure ammonium sulphate is required, the evaporation is stopped before this point is reached, and the residual liquor (Solution D) may then be diluted and mixed with a further quantity of the liquor entering or leaving the saturator. The actual procedure will depend on the free

acid content of Solution D. If Solution C is evaporated beyond the point referred to, the product obtained will contain a certain amount of sodium sulphate, but will still be available for use as a fertilizer.

Automatic Gas or Fluid Governors.—No. 114,247.

BENTLEY, J. E., of Blackpool.

No. 9787; June 29, 1917.

These improvements refer to governors wherein a floating needle valve is arranged to rise and fall under fluctuations of pressure, and thereby partially close or open the passage through which the gas passes. The improvements also refer, in particular, to governors in which the valve is provided with a flange at its wider end, and wherein the flanged end lies within a casing adjustable within the fixed outer casing of the apparatus.

In this type of governor as applied to a lighting burner, the valve is acted upon by the slightest pressure of gas—even when only sufficient gas is passing to maintain a pilot light. Now while a sensitive valve is very desirable for controlling the higher pressures, for lower pressures it is better to have no governing action at all; in fact, to allow for a slight increase in the volume of gas flowing to the burner when the pressure is reduced to the minimum. In known types of governor of this class, the valve flange when in its lowest position so reduces the passage for the gas that any sudden drop in pressure results in the light being extinguished, and unburnt gas escaping into the atmosphere. A further drawback is that when the gas is turned on, the lighting of other burners (which causes a reduction in pressure) results in a pronounced fluctuation in the gas-flame.

One of the objects of the present invention is to provide an arrangement in which no governing action at all takes place with relatively low pressures, or wherein the governing only takes place with relatively high pressures, and wherein a full-way passage for the gas is always maintained for the low pressures. A further object is to provide a governor in which, with fluctuations of the higher pressures, there is but little variation of the gas-flame.

APPLICATIONS FOR PATENTS.

[Extracted from the "Official Journal" for April 17.]

Nos. 5938—6314.

BESWICK, W.—"Gas generators or producers." No. 5974.
BUCKINGHAM, E. J.—"Coal-gas container." No. 6166.
BUCKINGHAM, E. J.—"Coal-gas compressor." No. 6167.
CANDY, H. E. L.—"Damper for gas flues and mains, &c." No. 6028.
DAILEY, H. C. R.—"Automatic gas-ration calculator." No. 6251.
HUMPHERSON, C. J.—"Gas and electric cooking-stoves." No. 6001.
LEMOINE, M. C.—See Candy. No. 6028.
MURPHY, S. J.—"Cylinders for containing gas or air under pressure." No. 6253.
PACKARD, F.—"Steam-condenser for gas wash-boilers." No. 6275.
PEARSON & SON, J.—"Treatment of coal-tar pitch, &c., for production of fuel." No. 6280.
REW, R. J.—"Retorts." Nos. 6077, 6313.
SIMPSON, C. W.—"Heating-flues of chambered ovens or retorts for producing gas and coke or fuel." No. 6230.
SMALLWOOD, A.—"Fire-grates or gas-producers." No. 6228.
SMITH, J. S.—See Pearson. No. 6280.
THORP, F. & H. T.—"Refining benzol, &c." No. 6306.
THYNNE, G. A. C.—"Application of gas-fires to earthenware fireplaces." No. 6020.
WATSON, D.—"Semi-rigid containers for gas." No. 6292.
WYLD, W. H.—"Treatment of ammoniacal liquors, &c." No. 6122.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF COMMONS.

A Select Committee on Sliding-Scale Bills.

For several days last week, a notice of motion stood on the Paper, in the name of Lord Edmund Talbot, for the appointment of a Select Committee to inquire into the question of "financial hardships" of gas undertakings; but on Thursday he withdrew his motion.

This announcement was, however, followed on Saturday by a statement in "The Times" that the Government had decided to appoint a Select Committee to consider and report whether it is expedient that some provision should be made for the temporary modification of statutory requirements with regard to price and dividend in the case of gas undertakings whose financial circumstances have been injuriously affected by causes arising out of the war; and, if so, on what terms and conditions, and whether by Private Bill or general legislation. Lord Edmund Talbot will shortly move in the House of Commons that the following should be members of the Committee: Mr. Acland Allen, Mr. Anderson, Mr. Allen Baker, Mr. Field, Mr. Fletcher, Mr. Macmaster, Mr. Ronald M'Neill, Sir William Middlebrook, Mr. Robinson, and Mr. Stewart.

Lighting Restrictions.

Mr. GILBERT asked the President of the Board of Trade whether his attention had been called to the hardship the proposed restrictions on gas and electric light consumption would have on all consumers who had already done their utmost to save consumption; and whether, with a view of altering this unfairness, he would allot consumption to each house on the basis of the number of rooms, on a similar plan to that of coal rationing, which had been such a success.

Sir A. STANLEY, in the course of his reply, said he did not think that the rationing of gas and electricity on the basis of the number of rooms would necessarily result in fewer anomalies than the method which has been adopted.

Mr. WILL THORNE asked Sir A. Stanley if he was aware of the many thousands of penny-in-the-slot and shilling-in-the-slot meters, and whether he could tell the House in what way he intended dealing with them.

Sir A. STANLEY said he was quite aware that there were a very great many automatic meters in existence. It was simply because there were such a large number of them that they found it necessary to make such restrictions as they thought would be least inconvenient.

Mr. WATSON asked whether special consideration was being given to people who could only light their premises by gas, and with whom any restriction of consumption would limit their hours of business.

Sir A. STANLEY replied that this had been borne in mind; but the fact remained that they must secure economy in the consumption of gas, and it must apply more or less to every consumer.

Mr. GILBERT asked when the gas undertakings would have the new suggestions ready for small consumers.

Sir A. STANLEY replied that they were moving as rapidly as possible in the matter; but it was a very complicated question.

ALDERSHOT GAS BILL.

HOUSE OF LORDS COMMITTEE.—Friday, April 19.

(*Before Lord* FORTEVIOT, *Chairman*, *Lord* LEIGH, *the Duke of* BUCCLEUCH, *Earl* STAFFORD, *and Earl* ELDON.)

This Bill, promoted by the Aldershot Gas, Water, and District Lighting Company, proposes an extension of the area of supply, both for gas and electricity, and seeks additional capital and other powers.

Counsel for the Bill were Mr. VESEY KNOX, K.C., and Mr. W. J. JEEVES. There were two opponents; the Aldershot Urban District Council being represented by Mr. CLODE, K.C., and the Farnborough Urban District Council by Mr. G. J. E. TALBOT, K.C.

Mr. VESEY KNOX, in opening, said the Company supplied gas over a wide district, water over a smaller area, and electricity over a still smaller area. The Company was incorporated in 1866, and the limits of supply then for gas and water were the town of Aldershot. Further powers were granted, as regards Aldershot, in 1879 and 1890; and in 1896 the Company amalgamated with the North Kent and Farnborough District Gas Company. In 1901, there was a further extension of the gas limits, and in 1909 still further extensions. The Aldershot area was known as the "A" area, the extensions granted in 1896 and 1901 were known as the "B" area, and the extensions of 1909 as the "C" area. The Company were allowed to charge a maximum of 1s. per 1000 c.ft. more in the "B" area than in the "A" area, and a minimum of 6d., and a similar differential as between the "B" and "C" areas. At the present moment the minimum of 6d. extra was being charged in "B" area. The Company had made remarkable progress during the past 22 years. In 1895, the total sales of gas were 94 million cubic feet; in 1900, they were 174 millions; in 1905, 250 millions; in 1910, 317 millions; in 1915, 485 millions; and in 1917 they were 543 millions. There had been a 7½ p.ct. increase per annum compound during this period. Considerable reductions in price had been made at the same time. In 1896, the price in Farnborough was 4s. 6d. per 1000 c.ft., and in Aldershot 2s. 9d.; while in 1914, before the war, the prices were 3s. and 2s. 4d. respectively, and 2s. for heating and cooking only. Owing to the increased cost of labour and materials due to the war, the prices now were 3s. 9d. in Farnborough and 3s. 3d. in Aldershot. In the "C" area, the price was 4s. 3d. The total capital of the Company was £370,550, with borrowing powers; and there was an overdraft at the bank. Of this, £100,000 was ear-marked for electricity and water; and no new capital powers were asked in respect of these. Part of the existing capital was under the sliding-scale—the standard dividends being 5 and 3½ p.ct.—and part was 5 p.ct. maximum dividend capital. The amount still available for gas purposes was about £100,000; but this was practically all allocated. Certain works were in hand, and would cost £33,000; the holder accommodation must be increased at the earliest possible moment, at a cost of £40,000; and the balance of the £100,000 would be required as working capital, which the conditions due to the war made it necessary to increase compared with what used to be regarded as normal. The Bill asked for £200,000 new capital, and the usual one-third borrowing powers—making £266,666. Originally, the Bill deposited, asked for £300,000. But in an endeavour to come to terms with the opposition, it had been agreed to reduce the amount; and he did not desire to go back on the agreement. At the same time, he regretted that it had not been possible to get rid of the opposition; and it was only right that he should tell the Committee that, for the usual period now taken in Gas Bills—viz., 12 to 15 years—£200,000 would be quite insufficient. The sum now being asked for would only take the Company on for six years. Evidently the local authorities had been misled into thinking that the capital expenditure of about £600 per million cubic feet—which was the common figure before the war—could still be adopted for such estimates; but the opinion of the Company now was that they could not work on less than £1000 per million cubic feet. The price of gas plant and machinery was 100 p.ct. over pre-war prices; and he would be a very rash man who would say that anything less than £1000 would be the figure during the next ten years. A large number of parishes were proposed to be added to the gas area originally; but only three were now proposed, and there was no opposition to them. The limits for electricity supply were proposed to be extended to coincide with the gas limits; and to this both Councils took objection. The Farnborough Council had an Order in 1899 to supply electricity; but it was revoked in 1904 because it had not

been put in operation. The fact was that in such areas as these it was impossible for anyone except a gas company to make an electricity undertaking profitable. Experience in many similar cases showed this to be the case. The Company began to supply electricity in part of their area in 1914; but in the two districts of Ash and Seal the powers were allowed to lapse, and it was now asked that they should be renewed. Eight miles of mains had been laid; and the consumption of electricity had increased from 42,000 units in 1915 to 163,000 units in 1917. The object in asking for the extension of area was to consolidate the business of the Company. A main nearly 2 miles long had been laid towards Camberley; but the work had been interrupted by the war. The Company had no electricity powers in Aldershot, where the Council had an undertaking. In a report on this part of the Bill, the Board of Trade called attention to the undesirability of giving powers for small generating stations, as the whole tendency in electricity supply was to generate at a few large centres. He submitted, however, that things could not stand still until the report of the Coal Conservation Sub-Committee had been acted upon. Such schemes as were referred to by the Board of Trade had no reference to districts like this; but the Board suggested that a clause should be inserted to the effect that if the Company was purchased, so far as its electricity undertaking was concerned, within seven years under such a scheme, no claim should be made for the powers obtained this year. A clause to this effect had been put in. The intention was to put up small generating plants in the districts of Fleet, Odiham, and Hartley Wintney—using in the latter two cases disused gas lands, and in all three instances employing gas-engines. This would be an advantage both to the districts in question and to the gas undertaking. Objection had been taken to the erection of standpipes for supplying motor vehicles with gas; but he understood there was now no opposition to this proposal. A difficulty, however, arose in regard to the use of the roadway in Ash Road, which ran through the works. At present the Company was only allowed to cross this by means of horse-drawn trucks—a slow and cumbersome method when there were locomotives available. The time of obstruction could be reduced by one-half if locomotives were used. The County Council, as the road authority, did not object; but the Aldershot Council did. The latter wanted their consent to be obtained; and the County Council claimed this as their right. It was not desirable that there should be two consents. Finally, Farnborough asked that the price in their district should be the same as in Aldershot. In present circumstances, this could not be conceded; but the Company promised to give the matter careful attention when things became normal. Objection was also taken to the co-partnership proposals in the Bill.

Mr. *R. W. Edwards*, the Managing-Director of the Aldershot Company, gave evidence in support of the opening statement. He estimated the consumption in ten years at 577 million cubic feet, or in seven years at 358 millions. At £1000 per million, the respective amounts of additional capital required would be £570,000 or £360,000. The sum asked for in the Bill, in consequence of the agreement with the local authorities, would not last the Company much more than six years.

The Committee adjourned until to-day (Tuesday).

PONTYPOOL GAS AND WATER BILL.

When this Bill last Wednesday came before a Committee of the House of Lords presided over by Lord Forteviot,

Mr. Honoratus Lloyd, K.C., for the promoters (the Pontypool Gas and Water Company), said that he had just been handed clauses from the only opponent—the Pontypool Urban District Council—which showed that there would be no preamble opposition. He expressed his regret that these clauses had not been submitted earlier, in order to have saved the sitting of the Committee, as there was no other Bill for consideration that day. He suggested a short adjournment in order that an endeavour might be made to come to a complete agreement.

Mr. Clode, K.C., for the Urban District Council, said the parties had been negotiating for some time; but it had been impossible to get the clauses prepared earlier.

After an adjournment, the Committee was informed that the parties had come to terms.

The Chairman commented on the fact that special protection had been given to the Great Western Railway Company in the matter of pressure.

Mr. Honoratus Lloyd explained that it was becoming usual to do this where it was possible.

Wages at Leeds.—The national award to gas workers gives an additional 4s. per week to Leeds employees, whose wages have been increased by 15s. per week, on five rises, since the outbreak of the war. The day workers' will average little short of £3 per week. The increase means an addition to the annual wages bill of the gas department of between £30,000 and £35,000.

Suggested Improvements at Dewsbury.—In presenting the new rate estimates to the Dewsbury Town Council, Alderman Sir Mark Oldroyd foreshadowed, in view of the rapid progress of invention, the partial, if not wholesale, scrapping of the Corporation gas and electricity works. The gas-works were now, for the first time for many years, unable to contribute anything to the relief of the rates; and he suggested that an expert be consulted as to immediate improvements. If the result were not satisfactory, he recommended an increase in the price of gas from 3s. 4d. to 3s. 6d. per 1000 c.ft. With the consumption of over 2000 million c.ft. per annum, and the present price of 3s. 4d., there was room for inquiry as to what results were being obtained in other boroughs, with a view to something better being accomplished at Dewsbury. Mr. Tom Myers strongly objected to the idea of an advance in gas charges, which were already higher than in other county boroughs. He considered the policy of making profits on municipal undertakings in order to relieve the rates was pernicious.

MISCELLANEOUS NEWS.

GAS RATIONING IN PARIS BY PRICE.

The Operation of a Two-Price Tariff.

The decision of the Paris Municipal Council on Dec. 31 last to increase the price of gas came into operation on April 1. The difficulties involved in effecting gas rationing by the application of a two-price tariff were recognized as formidable; but, according to the "Journal des Usines à Gaz," they appear to have been surmounted by the following regulations, which include within their scope not only prepayment meters but the subsidiary meters which, among certain sections of customers, draw their supply from a main meter, the readings of which are also registered. The official instructions for the new charges are as follows:

Price.

From April 1, 1918, and until further notice the price of gas to all consumers for all purposes is 40 c. per cb.m. (9s. per 1000 c.ft.), but 30 c. per cb.m. (6s. 9d. per 1000 c.ft.) where the daily consumption does not exceed 1½ cb.m. (53 c.ft.); the consumption being reckoned for each period between the two readings and without adjustment of one such period against another.

Regulation of the Change in Tariff.

The new tariff is applied uniformly to all consumers from April 1. Readings of meters are, however, taken in the ordinary course, and allowance made for the change as follows: April 1, being a holiday, in the case of readings taken from April 2 and on the days up to the end of the regular period, the making-out of a charge is effected by an estimate of the quantity consumed up to March 31 and that consumed subsequently. For this purpose, the quantity registered by the meter is divided by the number of days since (and including) that of the previous reading up to (but excluding) that of the subsequent reading. The quotient is the average consumption in the period in question.

The proportion of gas charged at the old rate of 20 c. per cb.m. (4s. 6d. per 1000 c.ft.) is obtained by multiplying this average consumption by the number of days up to and including March 31; while that for charge at the new rate is arrived at by multiplying the average by the number of days elapsed since April 1. If, owing to the absence of the consumer or other cause, the meter cannot be read by the Company's officers during the course of the first period of increased charge, the consumer is deprived of the benefit of the previous tariff, and the gas subsequently registered is charged wholly at the advanced rate.

Operation of the Two-Price Tariff.

Starting from the second period which follows April 1, the rules by which charges are made are as follows: Consumers are divided into two categories—(1) ordinary consumers; (2) consumers exempt from extra charges (premises of rent below 500 fr.). Each consumer has the right to consume, in the course of the year, at the rate of 53 c.ft. per day—548 cb.m. (19,350 c.ft.) at the reduced tariff. In the case of consumers of category (1), ten readings are made in the course of the year, and the quantity of gas available at 30 c. (corresponding to a total during the year of 548 cb.m.) is 55 cb.m. on each invoice. In the case of consumers of the second category, readings are taken five times during the year, and the quantity of gas purchasable at 30 c. is thus 110 cb.m. on each invoice. Nevertheless, this rule will be observed only when the number of days between two readings falls between 32 and 42 for the first category, and between 64 and 84 for the second category.

In cases where, in consequence of the restriction of staff, &c., the period of consumption is not comprised between the above limits, the quantity of gas subject to the reduced price will be calculated according to the exact number of days included within the period in question. In all cases where, as a result of the absence of the consumer, or from other cause for which he is responsible, the meter shall not have been read in the ordinary course by the Company's officers, the quantities of gas subsequently read and subject to the charge of 30 c. will be calculated as if the reading of the meter had been made in the ordinary course. As a result, whatever may be the interval of time, the consumer will benefit by the reduced tariff only in respect to the quantity of gas applying to a single normal period.

In the case of a consumer terminating his consumption during the course of the year, the regulation will be based on the exact number of days during the year on which gas was consumed. If for any reason the annual number of readings of meters (stated above as 10 and 5) requires to be modified by the Company, a similar regulation will be applied in accordance with the actual number of readings made.

Subsidiary Meters.

Any consumer controlling by a chief or main meter other so-called "subsidiary" meters will not be entitled to the benefit of the reduced price for a quantity greater than that to which he is entitled as an ordinary consumer. Nevertheless, in cases where premises provided with subsidiary meters are occupied by tenants not in the service of the consumer in whose name the main meter is registered and who pay a definite rent, a modification of this rule may be made on written application by the main consumer and on his undertaking to distribute the benefit of the reduced price among tenants drawing from subsidiary meters, also on the further condition that the readings of the subsidiary meters shall be taken by the Company's officers at the same time as that of the main meter.

Prepayment Meters.

Consumers supplied with prepayment meters are required to pay on the first demand, in addition to the sum deposited in the meter, a supplementary amount in correspondence with the operation of the new tariff. In case of non-payment of this supplementary charge, the supply of gas can be stopped in accordance with Article 93 of the Schedule of Charges of the Company, which is to the effect that, in default of payment within five days of the presentation of the account, the Company can refuse to continue the supply of gas. Consumers making use of prepayment meters are in no circumstances to oppose alterations to the mechanism of the meters for the purpose of bringing them into correspondence with the revised tariff.

SOUTH METROPOLITAN GAS COMPANY'S ASSESSMENT.

In a report to the Deptford Borough Council, the Finance Committee state that the question of the assessment of the South Metropolitan Gas Company's undertaking has occupied attention; and in this connection they have considered a report from Messrs. Dinwiddy & Sons. The report includes the following summary of the last four years' working of the undertaking:

	1914.	1915.	1916.	1917.
Gross revenue	£2,236,418	£2,646,888	£2,998,684	£3,352,446
Tenant's working expenses	1,242,696	1,676,507	1,920,153	2,354,093
	£993,722	£970,381	£1,078,531	£998,353
Repairs	526,444	446,099	537,209	552,568
Net receipts, *plus* rates .	£467,278	£524,282	£541,322	£445,785

From this summary, the Committee say, it will be seen that, though there has been an increase of nearly £1,120,000 in the revenue of 1917 over that of 1914, there has at the same time been a corresponding increase in working expenses and repairs.

Messrs. Dinwiddy have expressed the opinion that a re-valuation of the undertaking would not be opportune at the present time; and in this the Committee entirely concur.

QUALITY OF GAS AT BRIGHTON.

When the adoption of the proceedings of the Lighting Committee was moved in the Brighton Town Council last week, reference was made to the quality of the gas now being supplied by the Company.

Mr. BLACK, alluding to the last gas testing report, expressed the view that, as the quality had been very unsatisfactory lately, a summary of the test ought to be given in the *agenda*. He thought the report on the gas test would show that the gas was just as bad as ever, if not a little worse. Was it not a fact that the Portsmouth Corporation had taken proceedings against the local Gas Company with favourable result, and was not the gas supply there much better than at Brighton?

The TOWN CLERK: My answer is in the affirmative.

Mr. BLACK: Therefore an action at law can be maintained by a corporation when the gas is not so bad as in Brighton. Has the Town Clerk had instructions from the Electricity Department to institute proceedings against our Gas Company; and, if so, has he as yet taken any steps?

The TOWN CLERK: My answer is in the affirmative. Steps are being taken; and the matter is now receiving attention. I will not say that any actual legal process has been commenced.

Alderman COLBOURNE: Has the sanction of the Council been given?

The TOWN CLERK: It has not been reported to the Council.

Mr. BLACK demanded that steps should be taken to ensure as far as possible that a proper supply of gas should be given to the consumers in the town.

Mr. HEUN: I am rather surprised the Town Clerk did not say the Lighting Committee have by resolution asked him to take steps in the matter.

The TOWN CLERK: I said so.

The MAYOR (Alderman H. Carden): There are rather a lot of points to be considered.

The proceedings were approved.

MACCLESFIELD GAS-WORKS RESULTS.

Profitable Steaming in Verticals.

Last year the Macclesfield Corporation found themselves in the position—principally owing to the fact that the gas profits showed a reduction of £2500—of having to increase the rates by 6d. in the pound; but this year the Gas Committee have a disposable balance of £5971, which is £2346 more than twelve months ago. There has been an increase of about 5 p.ct. in the delivery of gas, and of about 4 p.ct. in sales during the year. By the introduction of "steaming" in the vertical retorts, it has been possible to increase the make per ton of coal carbonized from 14,282 to 16,054 c.ft. These figures form a record for the Macclesfield undertaking in the amount of gas made, and mean a considerable saving in coal, which more than counterbalances the increased charges for materials and higher cost of labour. In 1915 the make per ton was 12,049 c.ft.; and in 1916, 12,930 c.ft. There was a big improvement in 1917; and this year finds another increase of over 2200 c.ft. It has been decided to allocate £3000 of the profits to the maintenance fund, and £2971 to the relief of the rates. "Thus," says a local paper, "in a year of unexampled difficulty, with everything operating against the success of industrial undertakings in the high prices ruling for raw materials, advanced wages, reduced lighting, &c., the Engineer (Mr. J. E. Blundell) has been able to make a present to the ratepayers to the extent of almost an 8d. rate. This highly creditable result is entirely due to the initiative, the resourcefulness, and the enterprise of Mr. Blundell."

Recognition of Mr. Blundell's undoubted ability and devotion to the ratepayers' interests was made by the Chairman of the Gas Committee (Alderman Isherwood) at a recent meeting. On this occasion, Alderman Isherwood said he desired, not so much as Chairman, but as a member of the Committee for fully a quarter-of-a-century,

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to congratulate the Engineer and the ratepayers upon the result of the year's working. They had a gas-works and an Engineer and results second to none in the country—the profits which had been made in the past year had accrued through the industry and ability of Mr. Blundell, whose salary was only £350; and they would merely be doing justice by increasing it and giving that encouragement to the Engineer which he deserved, not so much because he had made this handsome profit, but for the ability he displayed in many directions. Mr. Blundell had produced an average of 16,000 c.ft. per ton for the year—a result which had never before been accomplished at their works. In the previous Engineer's time, the production was about 12,000 c.ft. per ton. In other words, if the extra 4000 to 5000 c.ft. per ton had not been produced there would have been no profits, but a heavy loss. Then they had had to pay something like £2000 advance in wages and materials; and the price of gas in Macclesfield was over 30 p.ct. below the average price in the country. Having regard to all the circumstances, Mr. Blundell was one of the lowest paid gas engineers in the country; and the ratepayers, he was sure, would not accuse them of extravagance in increasing his salary. He therefore proposed that the salary of the Engineer be increased from £350 to £400 a year. The motion was agreed to, with only two dissentients.

PROSPECTIVE DEMANDS AT BURTON.

Industrial developments in the district are necessitating the provision of further plant at the Burton-on-Trent Corporation Gas-Works. The consumption, after a decline, is now practically up to the pre-war level again; and certain large factories are not yet in working order.

The new plant, which is to be laid down immediately, is necessary in order to meet the estimated requirements of the town next winter. The extensions sanctioned by the Corporation must be completed before the existing boiler-house and exhauster-house can be taken down in order to make room for the extension of the newer retort-houses, which will probably be necessary next year as part of the general and larger scheme for increasing the productive power of the works. At the Government factory in Branstone Road there will be a very considerable demand for gas for industrial processes; and apart from this there will be a huge rubber works at Horninglow. Then hundreds of houses at present unoccupied, and others still to be erected under the Council's prospective planning scheme, have to be taken into consideration. The present capacity of the retort-houses is equal to about 2 million c.ft. per day, which is in excess of the size of the purifying and other plant. In the present year the latter is to be increased to such an extent that it will be equal in capacity to the full output of the existing retort-houses. The extensions contemplated for next year will bring the output up to 3 million c.ft. per day.

CURRENT SALES OF GAS PRODUCTS.

The London Market for Tar, Tar Products, and Sulphate.

London, *April* 22.

Pitch continues without change; the price of the article being maintained at not below 55s. per ton net, in bulk at makers' works. Solvent is steady at from 4s. 3d. to 4s. 6d. per gallon. Anthracene is 6d. per unit net, casks included.

In sulphate of ammonia there is nothing new to report.

Tar Products in the Provinces.

April 22.

The average values for gas-works products during the week were: Gas-works coal tar, 28s. to 32s. Pitch, East Coast 20s. to 25s. per ton; West Coast—Manchester 18s. 6d. to 19s. 6d., Liverpool 19s. 6d. to 20s. 6d., Clyde 19s. 6d. to 20s. 6d., nominal. Benzol 90 p.ct., North, 10½d. to 11½d.; 50-90 p.ct., naked, North, 1s. 3d. to 1s. 4d. Toluol, naked, North, 2s. 3d. Coal tar crude naphtha in bulk, North, 7¾d. to 8¾d. Solvent naphtha, naked, North, 3s. 10d. to 4s. Heavy naphtha, North, 2s. 6d. to 2s. 9d. Creosote, in bulk, North 4d. to 4¼d. Heavy oils, in bulk, North 4¼d. to 5d. Carbolic acid, 60 p.ct. East and West Coasts, 3s. 4d. naked. Naphthalene salts, 90s., bags included. Anthracene, "A" quality, 4d. to 6d. per unit; "B" quality, 1½d. to 2d.

FROM A MARKET CORRESPONDENT.

Tar Products.

After a few days of easier conditions, markets in tar products are now firmer again; and there are very few changes to record. As regards pitch, there are a good number of inquiries for forward delivery. This counteracts the detrimental effect produced by the falling-off of export business on account of the scarcity of freight, which is so pronounced that Channel traffic is practically held up. Tars are dull on account of an accumulation of stocks, which condition is likely to hold good until some arrangements are made for a better use of the product as a fuel. Very little prepared tar is being released for road purposes. Solvent naphtha is in good demand in London; but in the Provinces there has been a falling off in business—in fact, at times there has been a pressure to sell, with a consequent fall in quotations to about 3s. 9d. per gallon. Probably even this reduced quotation will not produce any increase of business. Heavy naphtha remains steady at 3s. 3d. per gallon. Cresylic acid is well bought, and makes 3s. 6d. per gallon, casks included. Benzol, toluol, creosote, and carbolic continue to be in great demand for official purposes, and are absorbed almost as fast as produced. Naphthalenes generally are much lower; the refined

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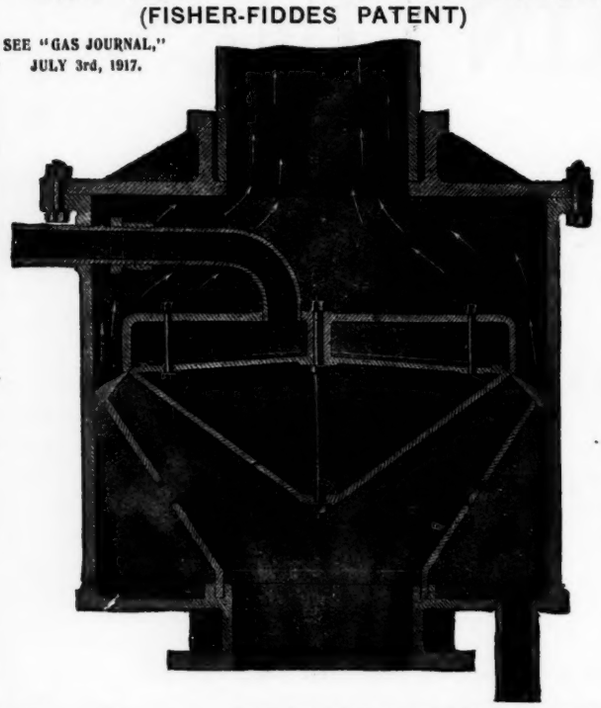

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being easier on an accumulation of stocks consequent upon a refusal of shipping licences. So far, however, prices are unaltered at from £30 to £32 per ton. Crudes are again lower, especially the cheaper sorts, which can now be obtained at from £6 5s. per ton; better sorts making up to £14 per ton. Anthracene is better at 4½d. per unit per cwt., and aniline oil is steady at 1s. 3d. per lb. The range of quotations is as follows:

Benzol: 90% London, 1s. 0½d., North 10½d. to 11½d.; 50% North 1s. 4d. to 1s. 5d. naked per gallon.

Carbolic Acid: 60% East and West Coast 3s. 6d. per gallon; crystals 40% 1s. 3d. per lb.

Crude Tar: London 32s. 6d. to 35s. Midlands 27s. to 29s.; North 28s. to 30s. per ton, *ex* works.

Pitch: London 48s. to 50s. f.o.b.; East Coast, 28s. to 30s. f.o.b.; West Coast—Liverpool 22s.; Manchester 25s. f.a.s.; Clyde 27s.

Solvent Naphtha: Naked London 90-190% 4s.; North 3s. 9d. per gallon; 90-160% naked London 4s. 3d. to 4s. 6d.; North 4s. to 4s. 3d. per gallon.

Crude Naphtha: Naked 30% 8¼d. to 8½d.; North 6½d. to 6¾d.

Naphthalene: Refined £30 to £32 10s.; salts 80s., bags included.

Toluol: Naked, London 2s. 4d.; North 2s. 3d.

Creosote: Nominal, London 4¼d.; North 4d. to 4¼d. (Government price, 75s. per ton f.o.b.—equal to 4½d. per gallon); heavy oil, 4¼d. per gallon in bulk.

Anthracene: "A" quality, 40-45%, 4½d. per unit; "B" quality, 1⅞d. to 2¼d.

Cresylic Acid: 95%, 3s. per gallon; 97-99%, 3s. 3d. to 3s. 6d. per gallon, casks included, *ex* works London and f.o.b. other ports.

Grease Oils 18° Tw. (naked) £6 per ton f.o.r. makers' works.

Sulphate of Ammonia.

There is little fresh news to record beyond the fact that the question of quotations for the next season are now coming in for much discussion in trade circles; and a meeting has been held in London lately in connection with the subject. So far nothing has been settled officially; but it is probable that an increase of 10s. per ton at least will be sanctioned for agricultural sulphate of ammonia, and that this increase will be for the latter, and not the earlier, part of the season. There are many sound reasons for an increase of price, chief of which is that present quotations are no better than pre-war prices, in spite of the heavier production expenses, and do not pay. Supplies are not plentiful; and every effort is being made to speed-up production to meet a much larger demand, both on official and agricultural accounts, in the coming season.

Mansfield Gas Undertaking.—The inability upon the part of the Mansfield Town Council to draw anything this year either from the gas or electricity undertaking in relief of municipal burdens is leading to the necessity for levying a district rate of 2s. 4d. in the pound for the half year ending September next. This is an increase of 5d.

Reading and the Gas Rationing Order.

In order to get full and authoritative information on the matter of the Lighting, Heating, and Power Order, a representative of the "Reading Standard" interviewed Mr. D. H. Helps, the Engineer and Manager of the Gas Company, who pointed out that the object of the Order is not to force consumers to give up the use of gas for cooking and heating, but to induce them to economize in the consumption of gas in fires, cookers, &c. To burn coal instead of gas would defeat the object of the Order. The use of gas for lighting, cooking, heating, &c., has been found so convenient and economical that in many cases sufficient care in its consumption has not in the past been practised; and the temporary call for economy will not cause much inconvenience if consumers will pay careful attention to all means whereby waste can be avoided. The interviewer pointed out the peculiar position in which Reading found itself, having regard to the influx of people from the Metropolitan area. A large percentage of them were in furnished apartments; and it was obvious they must necessitate an increase in the consumption of gas in such households. This contingency, Mr. Helps remarked, was not dealt with in the Order; and it was impossible to say what would be the position. It would, he said, be probably accepted by the authorities as an "explanation" for any apparent excessive consumption. The Reading Gas Company had anticipated some such Order as the present; for in November last they appealed to consumers to exercise all possible economy in the use of gas.

No Gas Boats at Hull.—The City Engineer has reported to the Hull Corporation Parks Committee that the use of petrol substitute and gas was now prohibited for pleasure boats. The regulations appeared to leave it open to the Petrol Controller to grant special permits, and he applied for such a permit; but it had been refused, although he pointed out that the East Hull Gas Company was not only able to supply the gas, but would welcome the additional consumption, such as it was, while the motor-boats were running. The consumption was only about 1000 c.ft. per working day; and in view of the thousands of children who derived pleasure from the trips, it was very much to be regretted that the use of the boats had to be discontinued.

Collecting Coins from Prepayment Meters.—Complaints are reported among North London gas consumers of the fact that their prepayment meters are choked with pennies, and they are therefore unable to get more gas. It is said that representatives of the Gas Light and Coke Company admitted to a "Daily Chronicle" man that they had many complaints from the Islington, Stoke Newington, and adjacent districts; but they were doing all in their power to overcome the difficulty, which arises from shortage of suitable labour. Women find the burden of heavy collections of coppers too serious for them, it is declared, and so the Company are enrolling time-expired or wounded soldiers. But new men cannot so quickly overtake arrears of collection as would others with more experience; and the consumers are therefore asked to exercise a little further patience.

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The Gas Restriction in London.

An official of the South Metropolitan Gas Company informed a representative of "The Times" that, while the operation of the "Curfew" Order has resulted in a reduced consumption of gas, the reduction falls considerably short of the one-sixth demanded by the Board of Trade. The dull, wet weather of the first half of the month has not encouraged economy; but if the new regulations are to be strictly observed, householders must keep a close eye on their meters as the quarter advances. The Company, to assist consumers, have arranged to take readings of the meters monthly instead of quarterly. Accounts, as formerly, will be sent in quarterly; but the monthly taking of the index will enable householders to be informed of the amount of gas they have used and the quantity to which they must restrict their consumption in the following months. If new appliances have been put in since March of last year, the Company, on the application of the customer, will assess the additional amount of gas which may be used. The Company, in a circular which has been issued to consumers, state that in many instances gas is wasted by inattention and by want of a little intelligent consideration; and they point out how economy may be effected. The Gas Light and Coke Company also have prepared circulars giving advice to their customers. "The Times" adds: It has been stated that the Board of Trade are prepared to give very sympathetic consideration to cases where the compulsory reduction of the use of gas or electricity presses hardly on those whose consumption, by the exercise of rigid economy, has been kept at a low level. As the whole purpose of the Order is to effect a saving in coal, it is probable also that favourable consideration will be given to consumers whose use of gas or electricity exceeds the rationed quantity if they can show that the consumption of coal for the household has been correspondingly reduced. One of the weak points of the Order is that it may drive people who have exercised all-round economy in lighting to use extra coal for cooking purposes.

Accident to a Gas Manager.—Mr. J. Furniss, the Manager (for forty years past) of the Slaithwaite (near Huddersfield) Gas-Works, suffered severe burns on Thursday, as the result of a mishap in connecting mains at the works. He was superintending the work in a trench when the bladder covering the pipe burst; and the escaping gas was ignited by a fire in the trench. Mr. Furniss was enveloped, receiving serious burns about the head, face, and arms.

Advance in Price at Doncaster.—The Doncaster Gas Committee have announced that, to meet the increased wages under the recent award by the Committee on Production, gas prices, as from May 1, must be advanced, as follows: For general purposes, from 3s. 3d. to 3s. 6d. per 1000 c.ft.; and for power, from 3s. to 3s. 3d.—both subject to existing discounts. Meter-rents will be: 3-light meter, 9d. per quarter; 5-light, 1s.; 10-light, 1s. 4d.; 20-light, 1s. 9d.; 30-light, 2s. 6d.; 40-light, 3s. 3d.; 50-light, 4s.; 60-light, 5s.; 80-light, 6s. 6d.; 100-light, 8s.; 150-light, 10s.; and larger sizes, by arrangement.

Use of Gas for Cooking in America.

Considerable activity has been directed by gas salesmen in the United States towards large-scale cooking; and Mr. R. B. Scarlett, of the Portland Gas Company (Ore.), prefaces an account of a hospital installation that has increased the consumption of gas 82,000 c.ft. per month, and at the same time has reduced the cost of fuel and labour about £50 per annum, by the remark that with one exception Portland is now an all-round gas-kitchen city, so far as large installations are concerned. The new installation comprises four large-size hotel ranges, with solid tops and fire-brick linings, set back to back a sufficient distance apart to allow of a 14-in. galvanized flue-pipe being fixed between them, and an independent damper-controlled vent from the back of each oven, which is carried into an upright shaft at one end. The whole arrangement, being below the level of the tops, is covered in with iron plates, forming one level table, and avoiding visible flues. The displaced arrangement was fired with coal and wood, which at 1916 prices (since substantially advanced) cost £9 per month, exclusive of time required for handling fuel, attendance to fire, and removal of ashes. Mr. C. B. Forbes, of New Orleans (La.), contributes to the American "Gas Age" an account of the introduction of gas into large-scale kitchens, sweets and sauce manufactories, &c., in his district, which had been successful in spite of the difficulty experienced in convincing the foreigners generally employed as chefs that charcoal was out of date. The first installation was made in 1912, and led other hotel proprietors to recognize the advantage of gas.

"Safety First" Council and Lighting Methods.—It has been resolved by the London "Safety First" Council to invite the Central Lighting Authority, through the Home Secretary, to adopt a diffused, substantially uniform illumination in all districts in the Greater London area, where military exigencies and local conditions permit; also to suggest to the lighting authorities in this area that, after the war, the use of appliances should be encouraged to provide diffused street illumination in substitution for the glaring lighting which prevailed before the outbreak of war. The President of the Local Government Board had become a Vice-President of the Council.

Increased Cost of Manufacturing Gas in the United States.—In the course of his Presidential Address to the New England Association of Gas Engineers, Dr. J. F. Wing referred to the increase in manufacturing charges within the last three years. At Chicago, they had advanced from 1s. per 1000 c.ft. in 1915 to 1s. 10½d. in 1917; and at Boston, taking the average for the three heaviest months in the year, the corresponding figures were: 1914-5, 1s. 0½d.; 1916-7, 1s. 1¼d.; and 1917-8, nearly 1s. 6d. In Massachusetts, 24 companies had raised the selling price, on an all-round average, 7½d.; and in New York State, 36 had followed suit, also stopping far below the corresponding advance in cost of production.

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Heckmondwike Official Sentenced.—On Monday of last week, at the West Riding Quarter Sessions, Allan Johnson Turner (33), until lately Cashier to the Heckmondwike and Liversedge Gas Company, was sent to prison for three months in the second division, on charges of falsifying the petty cash book of the Company and of stealing £124 15s. 8d. from the Company. He pleaded guilty, and said it was his first offence. He had been overworked for the past three years, and had lived beyond his income.

Work and Wages at Perth.—The Perth Gas Committee have been considering a list of employees at the gas-works over 65 years of age, and also of those under 65, whom the Manager (Mr. David Vass) considers unfit for full labourer's work, but useful on special work. Bailie M'Farlane moved that meantime, and during the war, the Committee on Production award should continue to be applied to all workmen concerned, leaving it to the Manager to report as to any one of them who was not carrying out his work satisfactorily. Mr. Wallace moved as an amendment that it be remitted to the Convener and Manager to draw up a full report as to the workmen—discriminating between those men who were fully capable of carrying out the duties required of them and those who were not so fully fitted for their work, and stating what proportion (if any) of the award the latter should be paid. On a division, the amendment was carried.

Cashel Gas Undertaking.—A meeting of Cashel (co. Tipperary) gas consumers appointed a deputation to submit to the Urban Council that the gas supply should not be discontinued, as proposed, and that the consumers were willing to meet the additional cost of producing gas caused by the increased price of coal. The Council having heard the deputation, notice of motion was given to rescind the resolution for the closing-down of the gas-works.

Bradford Municipal Workers' Wages.—Mr. J. B. Baillie, the Umpire in the arbitration between the Bradford Corporation and their employees in regard to the application for advanced war wages, has made his award. The employees, on the average, were getting 16s. per week above pre-war rates, and asked for £1; for equal pay for men and women on similar work; and for overtime at double pay on Sundays and holidays. Among general officials, clerks, inspectors, and collectors are granted, under the award, an increase of £6 10s. per annum for both men and women. Gas Department employees, exclusive of stokers, enginemen, coke-wheelers, and meter-repairers, receive an addition of 2s. 6d. per week to their existing bonus. Certain clauses of the award are not clear to both parties; and inquiries on these have been directed to the Umpire. A meeting of employees last week expressed keen dissatisfaction with the award; but in the meantime the items which are clear will be put into operation.

STOCK MARKET REPORT.

THE general position of affairs on the Stock Exchange last week showed a decided improvement upon the state of things which ruled in the week before, though it was not quite satisfactory from every point of view. As to the volume of business, for instance, it opened at very low pressure, and became day by day less and less until, on Thursday, the opinion was expressed that it must have reached about a record. But as regards the tone—in the leading markets at all events, if not in the miscellaneous department—the tendency was favourable. A short-lived cloud of dulness intervened on Tuesday; but thenceforth the atmosphere brightened, and was at its best at the finish.

The gilt-edged market once again was in the van of advance. The 5 p.ct. War Loan consolidated its position, closing very firm at 94¾, and the other loans and Consols also improved. Home Rails were so much neglected as to afford no characteristic. Much the same may be said of Canadians, but at the close they looked like waking up a bit. Argentines eased down in view of fresh labour trouble threatening.

In the Foreign Market, movements were irregular. A sharp jump in the Exchange sent Spanish down, and Russians were very dull. But French made a welcome recovery; and Japanese and Brazilian closed firm. The Miscellaneous Market was one of the dullest. Throughout the greater part of the week pretty well everything drooped persistently; but the tendency amended somewhat before the close. Rubber and Oil, which had been very weak, gave signs of a rally; and Textiles and Iron and Steel concerns stayed their fall.

Of business in the Gas Market, the tale is still the same. Week by week the tendency, almost without any pause, has been to grow quieter, and last week a condition of things was reached which is probably unprecedented, though possibly it may be surpassed at no distant date. The tendency was irregular. Gas Light ordinary and South Metropolitan were steady; but a few others of lesser degree were easier. Movements in quotation were adverse; Imperial Continental losing 1, Gas Light maximum 2, Newcastle 3½, and South Shields 5.

In the Money Market rates continued easy.

Bargains done for cash during the week were as follows: On Monday, British debenture 65, Gas Light ordinary 65, ditto preference 68, 68½, ditto debenture 55½, Imperial Continental 84½, Primitiva 35s., ditto preference 53s. 9d., South Metropolitan 63, 63¼, 63⅜, 63⅝, 64, Brentwood 7 p.ct. 77, 77½. On Tuesday, European 7⅞, Gas Light ordinary 65, ditto preference 68, 68½, Imperial Continental 84, Primitiva 35s., South African 9, South Metropolitan 63½, 63⅝, 63¾, ditto preference 94, ditto debenture 55½. On Wednesday, British 31½, Cape Town 3⅛, Gas Light ordinary 64⅛, 64⅜, Newcastle 70, Primitiva 35s., ditto preference 54s., River Plate debenture 59, 59½, South African 9 1/16, South Metropolitan 63¾. On Thursday, Gas Light ordinary 64½, 64⅝, Primitiva preference 52s. 6d., 54s., South Metropolitan 63, 63½, 63¾. On Friday, Gas Light ordinary 64, 64¼, 64⅜, ditto maximum 53, Imperial Continental 83, Monte Video 8¼, Oriental 103½, 104, Primitiva preference 52s. 6d., South Metropolitan 64, 64¼, ditto preference 94½, 94⅝.

The Bank rate is 5 p.ct., as fixed on April 5, 1917.

ANTE-WAR PRICES AND DIVIDENDS, LATEST DIVIDENDS, AND LAST WEEK'S BARGAINS.

Issue. £	Share.	When ex-Dividend.	Ante-War Dividend & Bonus p.c.	Last Dividend.	NAME.	Closing Prices, July 30, 1914.	Present Prices.	Lowest and Highest Prices of Bargains.
175,472	Stk.	Mar. 10	4	4%	Aldershot 4 p.c. Pref.	..	55—60	..
1,551,868	,,	April 8	2½	4⅜%	Alliance & Dublin Ord.	59—64	50—55	..
374,000	,,	July 10	4	4%	Do. 4 p.c. Deb.	76—79	68—63	..
280,000	5	April 29	7½	3/6	Bombay, Ltd.	5⅞—6⅛	5—5½	..
50,000	10	Feb. 26	16	13%	Bourne-mouth Gas and Water { 10 p.c.	29—30	22—24	..
883,110	10	,,	7	7%	B 7 p.c.	15—15½	10¼—10⅜	..
115,000	10	,,	6	6/-	Pref. 6 p.c.	13½—14	9—9½	..
159,740	—	—	—	4%	4 p.c. Deb.	..	67—69	..
992,045	Stk.	Feb. 26	14	11%	Brentford A Consolid.	261—266	76—79	..
784,920	,,	,,	11	4½%	Do. B New	204—209	73—76	..
55,000	,,	,,	5	5%	Do. 5 p.c. Pref.	109—111	79—84	..
221,400	,,	June 11	4	4%	Do. 4 p.c. Deb.	91—93	63—65	..
217,380	,,	Feb. 26	11	9%	Brighton & Hove Orig.	208—213	140—145	..
244,200	,,	,,	8	6%	Do. A Ord. Stk.	154—159	95—100	..
580,000	20	Mar. 26	12½	23/6	British	44—45	31—32	31½
120,000	Stk.	June 26	4	4%	Do. 4 p.c. Deb. Stk.	88—90	55—57	65
245,771	,,	,,	4	4%	Buenos Aires 4 p.c. Deb.	85—87	51—54	..
100,000	10	—	—	—	CapeTown & Dis., Ltd.	1½—2½	3½—3⅝	7½
100,000	10	—	—	4½%	Do. 4½ p.c. Pref.	4—6	7—8	..
100,000	Stk.	June 26	4½	4½%	Do. 4½ p.c. Deb. Stk.	70—75	58—63	..
157,150	,,	Feb. 26	5	5%	Chester 5 p.c. Ord.	108—110	79—81	..
1,518,280	,,	Feb. 12	5/9/4	41/4	Commercial 4 p.c. Stk.	106—108	67—69	..
560,000	,,	,,	5⅞	36/8	Do. 3½ p.c. do.	103—105	62—64	..
475,000	,,	June 11	3	3%	Do. 3 p.c. Deb. Stk.	69½—71½	52—54	..
800,000	,,	,,	4	—	Continental Union Ltd.	76—79	36—38	..
200,000	,,	,,	7	—	Do. 7 p.c. Pref.	115—118	60—62	..
278,400	—	—	—	11½%	Croydon B and C 7 p.c.	..	155—165	..
—	—	—	—	10%	Do. E	..	..	..
499,270	Stk.	—	6	5½%	Derby Con. Stk.	123—125	95—100	..
55,000	,,	—	4	4%	Do. Deb. Stk.	102—104	80—83	..
1,002,190	10	July 29	10	5/0	European, Ltd.	17½—18	7½—8½	7⅞
16,298,975	Stk.	Feb. 10	4/17/4	37/4	Gas 4 p.c. Ord.	98—102	63—65	64—65
2,600,000	,,	,,	3½	3½%	Light 3½ p.c. max.	76—79	53—55	53
4,062,235	,,	,,	4	4%	and 4 p.c. Con. Pref.	96—99	68—70	68—68½
4,074,850	,,	June 11	3	3%	Coke 3 p.c. Con. Deb.	72½—74½	55—57	55½
130,000	,,	,,	10	10%	10 p.c. Bonds	..	..	..
258,740	,,	Mar. 12	5	3½%	Hastings & St. L. 3½ p.c.	87—89	46—51	..
70,000	10	April 29	11	8%	Hongkong & China, Ltd.	16½—16¾	7⅞—8¼	..
86,600	—	—	—	9½%	Hornsey 7 p.c.	..	115—125	..
181,000	Stk.	Mar. 12	7½	7%	Ilford A and C.	151—154	90—95	..
65,780	,,	,,	6½	5½%	Do. B	115—118	70—75	..
65,500	,,	June 26	4	4%	Do. 4 p.c. Deb.	92—94	63—66	..
4,940,000	,,	May 14	9	4½%	Imperial Continental	150—160	83—85	83—84½
1,235,000	,,	Feb. 12	8½	8½%	Do. 8½ p.c. Deb. Red.	84—86	65—67	..
235,242	,,	Mar. 12	6½	6½%	Lea Bridge Ord. 5 p.c.	119—121	82—87	..
3,498,905	,,	Feb. 26	10	5%	Liverpool 5 p.c. Ord. A	211—213	82—84	..
					B	146—148		
906,088	,,	June 26	4	4%	Do. 4 p.c. Pr. Deb. Stk.	..	71—73	..
75,000	5	June 11	6	2/-	Malta & Mediterranean	4½—4⅝	3⅝—3⅞	..
250,000	100	April 1	4½	4½%	Met. of Melbourne 4½ p.c. Deb.	99—101	88—99	..
541,920	20	May 28	4	6/-	Monte Video, Ltd.	11½—12	8—8½	8½
1,875,892	Stk.	July 29	4½	3⅛%	Newcastle&Gatsh'd Con.	98¼—99½	69—71	70
529,705	,,	June 26	3½	3½%	Do. 3½ p.c. Deb.	82—83	63—64	..
55,940	10	Feb. 26	7/14/0	7/0	North Middlesex 7 p.c.	14—15	9¼—10½	..
800,000	Stk.	May 14	8	8%	Oriental, Ltd.	117—122	103—105	103¾—104
60,000	5	Mar. 26	10	1/-	Ottoman, Ltd.	7¾—7⅞	2—3	..
60,000	50	Feb. 26	13	10%	Portsea, Island B	125—131	82—87	..
100,000	50	,,	12	9%	Do. C	118—121	72—77	..
52,000	50	,,	10	7%	Do. D	..	..	..
249,980	5	April 29	8	—	Primitiva Ord.	5⅛—6	1⅝—1¾	35/-
499,960	5	June 26	5	2/6	Do. 5 p.c. Pref.	4⅝—5	2⅜—2½	52/6—54/-
621,600	100	June 2	4	4%	Do. 4 p.c. Deb.	91—93	76—78	..
—	—	—	—	4%	Do. ,, ,, 1911	..	..	..
846,198	Stk.	June 26	4	4%	River Plate 4 p.c. Deb.	85—87	57—62	59—59½
150,000	10	May 14	6	6/-	San Paulo { 6 p.c. Pref.	10⅛—11	7¼—7⅝	..
125,000	50	July 1	5	5%	{ 5 p.c. Deb.	47—49	40—42	..
135,000	Stk.	Mar. 12	10	10%	Sheffield A	223—224		..
209,984	,,	,,	10	10%	Do. B	222—224	174—177	..
533,500	,,	,,	10	10%	Do. C	220—222		..
90,000	10	May 28	9	6/-	South African	10½—11¼	9—10	9—9⅛
6,609,895	Stk.	Feb. 10	5/4/0	40/-	South Met. 4 p.c. Ord.	111—113	63—65	63—64½
—	—	—	—	—	Do. Pref.	..	93—95	94—94½
1,895,445	,,	July 10	3	3%	Do. 3 p.c. Deb.	72½—74½	54—56	55¼
224,220	,,	Feb. 26	8½	6%	South Shields Con. Stk.	157—159	123—131	..
962,795	,,	,,	6	4½%	S'th Suburb'n Ord. 5 p.c.	114—116	73—75	..
60,000	,,	,,	5	5%	Do. 5 p.c. Pref.	110—112	73—75	..
135,000	—	—	—	4½%	Do. West Kent	..	..	..
187,558	Stk.	June 26	5	5%	Do. 5 p.c. Deb. Stk.	116—118	84—86	..
647,740	,,	May 14	5	5%	Southampton Ord.	99—102	75—77	..
190,000	,,	Feb. 12	7½	5½%	Tottenham A 5 p.c.	135—138	90—95	..
782,275	,,	,,	6	4%	District B 3½ p.c.	115—117	67—69	..
181,255	,,	June 26	4	4%	4 p.c. Deb.	87—89	61—63	..
182,380	10	Dec. 30	5	—	Tuscan, Ltd.	5—6	1—2	..
149,900	10	July 1	5	5%	Do. 5 p.c. Deb. Red.	93—95	60—65	..
236,476	Stk.	Mar. 12	5	5%	Tynemouth 5 p.c. max.	108½—109½	87—88	..
					Wandsworth, Wimbledon, and Epsom—			
30,000	,,	Feb. 26	8⅜	67/6	Wandsworth A 5 p.c.	151—156	108—113	..
255,686	,,	,,	6⅝	52/6	Do. B 3½ p.c.	129—134	80—85	..
108,075	,,	,,	5/17/8	47/8	Do. C 3½ p.c.	110—115	80—85	..
852,000	,,	,,	6⅛	46/8	Wimbledon 5 p.c.	117—122	80—85	..
98,000	,,	,,	6⅝	52/6	Epsom 5 p.c.	121—126	80—85	..
88,416	,,	June 26	3	3%	3 p.c. Deb. Stk.	66—69	49—52	..

Dublin Gas-Workers' Wages.—Mr. Jas. Andrews, K.C., the Arbitrator on the question of £1 weekly increase on pre-war wages as asked by the workers of the Alliance and Dublin Consumers' Gas Company, has awarded 3s. to workers over 18 years of age, and 1s. 6d. to those under this age, as additions to bonuses already granted.

Keighley Wages Award.—The Committee on Production have awarded to the Keighley municipal gas workers an advance of wages equivalent to 19s. above pre-war rates (as against the existing 15s.) for men of 18 and over, and a 2s. per week advance to youths, with a maximum of 10s. over pre-war rates. These are to be war wages, and payable on overtime and night duty, Sundays, and bank holidays. Men of 21 and over who are paid at plain time rates are awarded a bonus of 12½ p.ct. on earnings.

Stafford Gas Undertaking.—At a meeting of Stafford Town Council last Tuesday, Alderman Westhead (Chairman of the Gas Committee) mentioned that the 16s. weekly bonus granted as a result of the arbitration to the gas employees last January had since been increased to 20s. per head. This would involve an additional expenditure of from £2500 to £2800 per annum—equivalent to an increase of 2½d. to 3d. per 1000 c.ft. in the price of gas. The Gas Committee estimated that, out of their profits for the year ended March 31 last, the sum of £1000 would be available in aid of the district fund. Mr. Simmons protested against the proposed allocation of money from the gas profits to the rates; urging that it was bad finance, and unfair to the ratepayers. He moved an amendment for the deletion of the paragraph relating to this matter; but the amendment was defeated.

WANTED, FOR SALE, CONTRACTS, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

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